OUTCOME AND EVALUATION OF MINI INCISION RELEASE FOR CARPAL TUNNEL SYNDROME

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BY

DR. ASHISH MONGA

SUPERVISOR

DR. PANKAJ MAHINDRA

DEPARTMENT OF ORTHOPAEDICS

DAYANAND MEDICAL COLLEGE AND HOSPITAL

LUDHIANA

(MAY, 2020)

DECLARATION

I declare that the thesis entitled **"OUTCOME AND EVALUATION OF MINI INCISION RELEASE FOR CARPAL TUNNEL SYNDROME"** has been prepared by me under the guidance of **Dr. Pankaj Mahindra,** Associate Professor, Department of orthopaedics, Dayanand Medical College and Hospital, Ludhiana. No part of this thesis has formed the basis for the award of any degree previously.

_____

Dr. Ashish Monga
Department of Orthopaedics
Dayanand Medical College & Hospital
Tagore Nagar
Ludhiana-141001
Punjab

Date:

CERTIFICATE

I certify that **Dr. Ashish Monga** has prepared his thesis entitled **"OUTCOME AND EVALUATION OF MINI INCISION RELEASE FOR CARPAL TUNNEL SYNDROME"** for the award of degree of M.S. in Orthopaedics of Baba Farid University of Health Sciences, under my guidance. He has carried out the work at the Department of Orthopaedics, Dayanand Medical College & Hospital, Ludhiana.

Supervisor

Dr. Pankaj Mahindra
Associate Professor
Department of Orthopaedics
DMCH, Ludhiana

Co-Supervisor

Dr Rajnish Garg
Prof & Head
Department of Orthopaedics
DMCH, Ludhiana

Dr. Rajinder Bansal
Professor
Department of Neurology
DMCH, Ludhiana

Date:

ENDORSEMENT BY THE HEAD OF THE DEPARTMENT AND PRINCIPAL

This is to certify that the thesis entitled **"OUTCOME AND EVALUATION OF MINI INCISION RELEASE FOR CARPAL TUNNEL SYNDROME"** is a bonafide research work done by **Dr. Ashish Monga** under the guidance of **Dr. Pankaj Mahindra**, Associate Professor, Department of Orthopaedics, Dayanand Medical College & Hospital, Ludhiana.

Head of Department

Dr. Rajnish Garg
Professor & Head
Department of Orthopaedics
DMCH, Ludhiana

Principal

Dr. Sandeep Puri
Principal
DMCH, Ludhiana

Date:

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Dr. Ashish Monga
Department of Orthopaedics
Dayanand Medical College & Hospital
Tagore Nagar
Ludhiana-141001
Punjab

Date:

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Faridkot

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ABBREVIATIONS

BCTQ	Boston Carpal Tunnel Syndrome Questionnaire
BWCTQ	Brigham and Women Carpel Tunnel Questionnaire
CTR	Carpel tunnel Release
CTS	Carpal Tunnel Syndrome
C5	Cervical Vertebrae
DM	Diabetes Mellitus
ECTR	Endoscopic Carpel Tunnel Release
EMG	ElectroMyography
FSS	Functional Status SCO
GA	General Anaesthesia
GSS	Global Symptom Serving Score
HTN	Hypertension
LA	Local Anaesthesia
NCS	Nerve Conduction Study
OCTR	Open Carpel Tunnel Release
RA	Rheumatoid Arthritis
SSS	Symptomatic Severity Score
VAGUSS	Visual Analog Patient Satisfaction Score
VAS	Visual Analog Scale

KEY TO MASTER CHART

APB	ABDUCTOR POLICIS BREVIS
B/L	BILATERAL
DM	DIABETES MELLITUS
F	FEMALE
F1	Writing
F2	Buttoning clothes
F3	Holding book
F4	Holding phone
F5	Opening of jars
F6	Household work
F7	Carrying market bags
F8	Bathing and dressing
HTN	HYPERTENSION
M	MALE
N	NEGATIVE/NO
NW	NON WORKING
PARA	PARAESTHESIA
PRE	PREOPERATIVE
POST	POSTOPERATIVE

ABSTRACT

Introduction-. Carpal tunnel syndrome (CTS) is a condition in which the median nerve is compressed as it crosses the wrist, causing paraesthesia or numbness in the area of the median nerve, associated with pain. Nocturnal pain that wakes patients up is also common. In severe cases, there may be atrophy of the thenar musculature and weakness of thumb opposition

Aims and objectives- To study the outcome of mini-incision release in patients of carpal tunnel syndrome and to evaluate functional outcome. To assess the complications associated with it.

Material and methods- Study would be based on a retrospective and prospective review of the medical records of all cases of CTS who had undergone MINI-INCISION RELEASE between January 2017 and June 2019 at Dayanand Medical college Hospital, Ludhiana. Patients will be followed up monthly by clinical examination and final assessment will be made using 6 months after surgery whichever is later.

Results- The mean preoperative GSS score was 33.44± 6.75 which improved to 7.17 ± 2.44 postoperatively. The mean FSS- SCORE of 41 patients improved from 28.29 ± 3.40 to 11.44 ± 5.38post operatively. FSS and GSS score to post-operative outcome was found to be statistically significant (p 0.000).

Conclusion- We concluded that Mini incision release for carpal tunnel syndrome is very successful surgery which yields a large degree of symptom relief and improvement in health related quality of life. It is less invasive technique with minimal complications, shorter operative time, and more cost-effective.

Keywords- Median nerve, Mini incision release, carpal tunnel

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INTRODUCTION

Carpal tunnel syndrome (CTS) is a condition in which the median nerve is compressed as it crosses the wrist, causing a set of signs and symptoms. Patients generally complain of constant or intermittent paresthesia or numbness in the area of the median nerve, which may be associated with pain. Nocturnal pain that wakes patients up is also common. In severe cases, there may be atrophy of the thenar musculature and weakness of thumb opposition.[1]

CTS is the most common compressive neuropathy, occurring in around 0.1% to 10% of the general population. The risk factors include obesity, hypothyroidism, diabetes mellitus, pregnancy, kidney disease, inflammatory arthritis, acromegaly, mucopolysaccharidosis, genetic predisposition, advanced age, smoking, and repeated and extreme flexion of the wrist at work.[1,2,3,4] According to Souza, CTS is the compressive neuropathy most frequently associated with repetitive strain injury Carpal tunnel syndrome has become one of the most frequently reported work injuries. It has become a serious concern in the health field; however, it has potential for prevention through the work-place and by work practice changes. Following are just a few of the main work-related causes of carpal tunnel syndrome:

Repetitive motion due to wrist flexion and extension, gripping an object while bending your wrist in the direction of your little finger (also called ulnar deviation). Blunt forces on the palm of the hand, and vibrating forces. These unnatural positions or movements, when constantly repeated, can lead to an accumulative trauma disorder the classification for carpal tunnel syndrome. Months or even years of misuse or abuse of the hands and wrists can result in pressure being placed on the median nerve due to swelling of the tendons and sheaths that surround them, resulting in a pinching-type effect, which can damage the median nerve. This swelling of the ensheathing synovial tissues of the tendons causes pressure build-up in the U-shaped canal, which (according to Akelman

and Weiss in their article, "Carpal Tunnel Syndrome: Etiology and Endoscopic Treatment"), can result in blockage of capillary blood flow to the median nerve. This results in symptoms of pain, numbness, and tingling.

The diagnosis of CTS is eminently clinical, based on clinical history and physical examination, and confirmed by electroneurophysiological studies. Souza[5] states that clinical diagnosis, with the Tinel and Phalen tests, is sufficient, when related to patients' complaints. Other pathologies (such as cervical radiculopathy, brachial plexus lesions, thoracic outlet syndrome, apical pulmonary neoplasia, pronator syndrome, cubital and ulnar tunnel syndromes, and peripheral neuropathies) may cause paresthesia in the hand and should be excluded from the diagnosis.[6,7] A combination of findings from the clinical history and physical examination is more trustworthy than just one separate sign or symptom. CTS is accurately diagnosed in most cases when found in association with nocturnal pain, a positive Tinel's test, painful carpal tunnel compression test (Durkan test) and positive Phalen test.[1,3,6,8,9] According to Howard, Durkan's test has the highest sensitivity for detecting CTS upon physical examination.[2] Electrophysiological tests (nerve conduction velocity and electromyography) are used to confirm the clinical diagnosis. A pathological nerve conduction velocity study includes decrease in action potential amplitude, increase in distal latency and decrease in speed. Distal motor latency of more than 4.5ms and sensory latency of more than 3.5ms are abnormal.[1,3,9] On the other hand, Howard states that distal sensory latencies above 3.2ms and motor latencies above 4.2ms are already abnormal.[2] Abnormal electromyographic findings include diminished insertion activity, fibrillation at rest, positive sharp waves and complex repetitive discharges, as well as diminished motor unit recruitment. The clinical profile is often so classic that the signs and symptoms are sufficient to establish the diagnosis,[6] but electroneuromyography should be considered in the preoperative

planning, even though it is uncomfortable for the patient. It is also a way of documenting the patient's case for legal purposes.[4,7] The treatment may be conservative or surgical, and there are various surgical techniques for decompression.[4] The conservative treatment for CTS includes modification of activities, nocturnal immobilization of the wrist, injection of corticosteroids into the carpal canal, and oral medications.[1,2] The corticosteroid injection into the carpal canal combined with nighttime immobilization has an early success rate of around 80% in symptom improvement. However, after 12 to 18 months, only 22% of the patients remain free from symptoms.[1] Howard states that 40% of the patients remain free from symptoms after the corticosteroid injection into the carpal tunnel, when the symptoms have been present for less than a year.[2]

Since the surgical treatment was introduced, carpal tunnel release has been extensively reviewed and many modifications have been suggested with different instruments and incision techniques. Traditional open release has been the standard approach worldwide since Phalen promoted it in 1950.[10]

The surgeries described in literature for CTS can be classified into endoscopic and nonendoscopic methods of carpal tunnel release. Nonendoscopic release procedures comprise traditional release, limited incision release, and mini-incision release.[11]

Effectiveness and safety of these various methods still remain controversial. The traditional open release has a few associated incidence of hypertrophic scarring, scar tenderness, pillar pain, and delayed return to work.[12-16]

Limited incision method, mini-incision methods, and endoscopic methods all are proposed to be effective for preventing the excessive scar formation, reducing pillar pain, and the early return to work.[17-19] The limited release techniques claim to have most of the advantages of endoscopic release with almost similar end results and lesser learning curve.[20]

The advantages cited with endoscopic release over open method are decreased postoperative morbidity, early return to work, aesthetic scar. Still there are complications documented such as laceration of the superficial palmar arc, median nerve transection, injuries of digital nerves, vessels, and insufficient release of the carpal tunnel.[21]

The metaanalysis by Thomas *et al*. which compared two techniques of open and endoscopic surgery showed that endoscopic technique had less pain in the incision site and better improvement in grasping objects at 12 weeks, but there was three times greater likelihood of nerve damage than the open surgery group.[22] There are also concerns regarding duration of surgery, cost of surgery, equipment cost, and surgical training required.

The purpose of this prospective study was to look into technique of mini-incision carpal tunnel release to evaluate its effectiveness clinically and neurologically.

ANATOMY OF CARPAL TUNNEL

The carpal tunnel is an inelastic fibro-osseous tunnel defined by the carpal bones and the flexor retinaculum. The osseous components of the carpal tunnel form an arch, defined by four bony prominences – proximally by pisiform and tubercle of scaphoid and distally by hook of the hamate and tubercle of trapezium. Superficially the palmaris longus tendon passes anterior to the flexor retinaculum to become continuous with the palmar fascia. Deep to the palmar fascia, a thick ligamentous band forms the superficial border of the carpal tunnel, also referred to as the transverse carpal ligament. The flexor retinaculumand the transverse carpal ligament are considered by some authors synonymous terms. The anatomic zone of the flexor retinaculum extends from the distal radius to the proximal metaphysis of the thirdmetacarpal. It is firmly attached to the hook of the hamate and pisiformbones on the ulnar (medial) side of the carpal tunnel and the tubercle of the trapeziumand distal pole of the scaphoid on the radial (lateral) side of the carpal tunnel. The flexor retinaculum may be divided into three distinct components. The proximal portion is a direct

continuation of the deep antebrachial fascia. Distally, the transverse carpal ligament represents the central portion of the flexor retinaculum. Most distally is an aponeurosis between the thenar and hypothenarmuscles

Although the carpal tunnel appears to be in open communication with the flexor compartment of the forearm proximally and the midpalmar space of the hand distally, it behaves like a closed compartment and maintains its own tissue fluid pressure levels Longitudinally the carpal tunnel is narrowest 2–2.5 cm distal to its most proximal margin (approximately at the hook of the hamate) with a mean width of 20 mm, expanding to a mean width of 25 mm at its proximal and distal margins. The transverse carpal ligament is thickest at the level of its attachment to the hook of the hamate and the tubercle of the trapezium, which is also the most narrow region of the carpal tunnel.

The radial side of the flexor retinaculum splits to formaseparate tunnel for the tendonof the flexor carpi radialis muscle, forming in essence a superficial and deep layer of the retinaculum.

This tunnel is directly continuous with the fibro-osseous tunnel forthe flexor carpi radialis tendon that forms anterior to the distal pole of the scaphoid and continues distally dorsal to the trapezial ridge. The principle contents of the carpal tunnel are the median nerve, typically accompanied by the highly variable arteria mediana, and nine extrinsic flexor tendons. The median nerve is composed of branches from the C5 through T1 spinal cord nerve roots. It travels distally in the forearm between the flexor digitorum superficialis and profundus muscle bellies, often within the deep epimysium of the flexor digitorum superficialis. In the distal forearm, the median nerve becomes more superficial, coursing between the tendons of flexor digitorum superficialis ulnarly and flexor carpi radialis radially, dorsal or dorsoradial to the palmaris longus tendon. Approximately 5 cm proximal to the wrist crease, hence proximal to the cephalad margin of the carpal tunnel, the palmar cutaneous branch of the median nerve diverges. It parallels the median nerve for 1.6–2.5 cm and then courses separately

under the antebrachial fascia between the tendons of palmaris longus and flexor carpi radialis. The palmar cutaneous branch of the median nerve then pierces the deep antebrachial fascia, becoming superficial to the flexor retinaculum, approximately 0.8 cm proximal to the wrist crease. It then divides into one radial and one or multiple ulnar branches which innervate the palmar skin of the proximal hand. After exiting the carpal tunnel the median nerve divides into six terminal branches. The recurrent motor branch supplies afferent innervation to the thenar muscles (flexor pollicis brevis, abductor pollicis brevis, and opponens pollicis). There are three proper digital nerves, including the radial and ulnar proper digital nerves to the thumb and the radial proper digital nerve to the index finger. These may emerge from the median nerve as a common digital nerve. Finally, two common digital nerves emerge from the median nerve. The second common digital nerve divides to form the ulnar proper digital nerve of the index finger and the radial proper digital nerve for the long finger, and the third common digital nerve divides to form the ulnar proper digital nerve for the long finger and the radial proper digital nerve for the ring finger. The first lumbrical muscle is innervated by motor branches that originate from the radial proper digital nerve to the index finger; the second lumbrical muscle is innervated by motor branches that originate from the second common digital nerve.

AIMS AND OBJECTIVES

1. To study the outcome of mini-incision release in patients of carpal tunnel syndrome.
2. To evaluate the functional outcome of operatively managed patients.
3. To access the complications associated with Carpal tunnel syndrome

REVIEW OF LITERATURE

Mardanpour et al in 2019 conducted a study in which, 300 carpal tunnel release operations were done on 188 patients using 1.5 cm longitudinal mini-incision. During surgery procedure, there is no evidence of local hematoma or nerve injury. There are no procedure-related complications such as skin infection, tenderness of scar, excessive scar formation, and stiffness during the follow-up period. All symptoms have been relieved immediately after surgery and full recovery after surgery took average 2 months for all patients. Therefore, there are no reasons for procedure failure. In our study, no patient required repeat operations. The mean time recovery appeared to be fast and generally stay out of work for at least 2 weeks return to daily activities and all patients recover completely.[23]

Gurpinar et al in 2019 conducted a study on a total of 54 patients were operated with the ECTR technique and 50 patients were operated with the OCTR technique. The operation times in the open group and endoscopic group were 18.5 ± 2.5 min and 18.2 ± 2.3 min, respectively. In the ECTR and OCTR groups, the preoperative or postoperative CTS-SSS and CTS-FSS values did not differ significantly ($p > 0.05$). Postoperative CTS-SSS and CTS-FSS values were significantly ($p < 0.05$) decreased compared to the preop period in both groups. In the OCTR group, the 3rd month, 6th month, and last follow-up pillar pain rates were slightly higher than the ECTR group, but there was no significant difference between the two groups ($p > 0.05$). In the ECTR and OCTR groups, follow-up time, satisfaction rate or complication rate were not significantly different ($p > 0.05$)[24]

Chen et al in 2017 presented a case series of 49 cases of idiopathic CTS treated with the mini-incision technique using nasal instruments. The average recovery days before return to normal work and complications were recorded. The mean grip strength, pinch strength, and sensation were evaluated. Subjective results were evaluated using the visual analogue scale (VAS), Levine Carpal Tunnel Syndrome Questionnaire

(LCTSQ), Disabilities of the Arm, Shoulder, and Hand (DASH), and Medical Outcomes Study (MOS) 36-item short-form health survey (SF-36). The mean follow-up was 13 months. No return of symptoms or blood vessel injury occurred. The incidence of scar tenderness was only 8.1%, later pillar pain (after 4 weeks) was 18.4%, and average recovery time to return to normal work was 23.7 days. The mean grip strength, pinch strength, and sensation were significantly improved ($P<.001$). The VAS, LCTSQ, and DASH survey postoperative mean scores were lower than the preoperative scores ($P<.001$). SF-36 scores were significantly increased following surgery ($P<.001$).

They concluded that the mini-incision technique for CTR using nasal instruments in Chinese patients is safe, effective, and low cost. It is worthwhile for the technique to be promoted and used.[25]

Gaba et al in 2017 conducted a study on twenty seven cases (9 male and 18 female, age 28–56 years) of isolated CTS cases were enrolled in the study. A total of 33 hands (six bilateral) underwent limited incision carpal tunnel release. In this study, two mini-incisions were used and release was done with the help of nasal speculum**.** All the patients had good clinical and neurological outcome with no recurrence during followup. The first symptom to get relieved was night pains, with a mean of 4.5 days (range 2–14 days). Compared to pain, improvement of sensory symptoms was delayed; the mean duration was 42.8 days (range 30–90 days). Scar tenderness was present only for a mean duration of 9 days (range 7–21 days). The mean duration for patients to resume their daily activities was12 days (range 7–28 days) and to work was 32 days (range 21–90 days). Limited incision carpal tunnel release can be considered a feasible alternative to traditional open release and endoscopic release.[26]

Thomas et al in 2016 conducted a study on 50 cases (5 cases being bilateral) of carpal tunnel syndrome were operated between 2012 to 2014. All cases were done under local anesthesia. Patients were retrospectively evaluated and interviewed for 2 months follow up after

the surgery. Out of the 50 patients who had undergone surgery, 44 patients (88%) had symptomatic relief in the first 10 days. Remaining patients had symptomatic relief in 2 months' time. Surgery is always the preferred treatment for carpal tunnel syndrome. In my study, 6 patients (12%) had long standing carpal tunnel syndrome, hence it took 2 months for symptomatic relief. Remaining patients had symptomatic relief in the first 10 days.[27]

Hamawandi et al in 2014 conducted a study to analyze the results of patients who were operated by using 1.5 cm palmer skin incision. (228) carpal tunnel release operations were performed on (181) patients. These patients were assessed pre and postoperatively using Visual Analog Scale (VAS) and Visual Analog Patient Satisfaction Scale (VAPSS) [1]. The (1.5) cm palmer skin incision technique for carpal tunnel release is a safe and effective surgical procedure. It can be used in the surgical treatment of CTS to achieve better cosmetic results and to reduce the complications of other standard techniques.[28]

Castillo et al in 2014 conducted a study on patients with isolated carpal tunnel syndrome were randomized to undergo either single-incision or two-incision CTR by a single surgeon at a university medical center. There was no statistically significant difference between the single- and two-incision CTR groups with respect to pre- and post-operative DASH scores, BWCTQ scores, grip strength, pinch strength, scar tenderness, or pillar pain. The only statistically significant difference was improved sensation by Semmes-Weinstein in the single-incision group in the second finger at 6 weeks post-operatively and in the third finger at 6 months post-operatively. The preservation of the superficial nerves and subcutaneous tissue between the thenar and hypothenar eminences may account for reports of less scar tenderness and pillar pain among recipients of two-incision CTR compared to single-incision CTR in the early post-operative period. However, there is similar post-operative recovery and

improvement in grip and pinch strength and sensation after 6+ months post-operatively.[29]

Korkmaz et al in 2013 in his study included 93 hands of 79 patients with carpal tunnel syndrome (CTS), which were operated between 2007 and 2009. Patients were divided according to incision types into Group-1 (undergoing mini-longitudinal incision) and Group-2 (undergoing mini-transverse incision). Patients were evaluated initially and at 3 weeks after treatment according to symptom severity and functional status of Boston Questionnaire (BQ). Demographic and clinical data were analyzed and compared statistically between two groups. Statistically significant differences were observed in BQ symptom and functional scores between the pre- and postoperative period ($p < 0.0001$). BQ symptom and functional scores at postoperative period were better in Group-1 than Group-2 ($p = 0.044$ and $p = 0.023$ respectively). The scar hypersensitivity ($p = 0.258$) and tenderness ($p = 1.00$) associated with the incision sites were not statistically different. Longitudinal incision is more effective on symptom and functional conditions than transverse incision. However, there was less scar formation with transverse incision.[30]

Heidarian et al in 2013 published study on "Comparison of Knifelight Surgery versus Conventional Open Surgery in the Treatment of Carpal Tunnel Syndrome". To compare the Knifelight instrument and open carpal tunnel release with respect to scar length, operation duration, recovery time needed before return to work and amount of pain three weeks after surgery in patients with neurophysiologically confirmed carpal tunnel syndrome. Fifty nine patients with indication for carpal tunnel release randomly assigned into two groups: open (n=30) or Knifelight (n=29). The patients compared regarding scar length, operation duration, time to return to daily activities and amount of pain at three weeks after operation based on Visual Analog Scale. There was no significant differences regarding age and sex in the two groups. The scar length, operation duration and time before return to daily activities were significantly lower in the

Knifelight group. Although the mean visual analogue scale of Knifelight group found to be lower than the other, it was not statistically significant. The Knifelight technique is accompanied with advantages over the open surgery regarding operation time, scar length and time to return to daily activities. The pain relieve based on Visual Analog Scale was not statistically different from conventional open surgery.[31]

Kim et al in 2013 published study on "Pressure-morphology relationship of a released carpal tunnel". In which Carpal tunnel release (CTR) was performed endoscopically on cadaveric hands and the carpal tunnel pressure was dynamically increased from 10 to 120 mmHg. Simultaneously, carpal tunnel cross-sectional images were captured by an ultrasound system, and pressure measurements were recorded by a pressure transducer. Carpal tunnel pressure significantly affected carpal arch area ($p < 0.001$), with an increase of >62 mm(2) at 120 mmHg. Carpal arch height, length, and width also significantly changed with carpal tunnel pressure ($p < 0.05$). As carpal tunnel pressure increased, carpal arch height and length increased, but the carpal arch width decreased. Analyses of the pressure-morphology relationship for a released carpal tunnel revealed a nine times greater compliance than that previously reported for a carpal tunnel with an intact TCL. This change of structural properties as a result of transecting the TCL helps explain the reduction of carpal tunnel pressure and relief of symptoms for patients after CTR surgery.[32]

Sanati et al in 2012 published study on "Surgical techniques and return to work following carpal tunnel release: a systematic review and meta-analysis". This systematic review was conducted to evaluate return to work (RTW) following minimally invasive carpal tunnel surgery versus open carpal tunnel release. This study also assesses how RTW as an outcome measure was examined in previous randomized controlled trials (RCTs). The bibliographic databases Medline, AMED and CINAHL were systematically searched. We found 15 relevant RCTs. Meta-analysis was

possible only for four studies. The result indicates that minimally invasive surgery offers earlier return to work compared to open carpal tunnel release (mean difference -7.2 days; 95% CI -10 to -4.4 days).[33]

Sever et al in 2010 conducted a study on forty-five patients (15 male, 30 female, age 28-62; mean 48) with isolated carpal tunnel syndrome were enrolled to the study. A total of 55 wrists (bilateral in 7 cases, the right wrist in 41 and the left wrist in 14) underwent carpal tunnel decompression with a mini longitudinal incision technique. Grip strength--key pinch and sensorial evaluations were performed in all patients by one examiner using the Pressure-Specified Sensory Device.Significant differences between the pre- and postoperative periods were observed in either grip strength or pinch strength ($p<0.05$). No recurrence or injury to the neurovascular structures was noted in the follow-up period.[34]

Wongsiri et al in 2008 published study on "A new tool for mini-open carpal tunnel release the PSU retractor". Mini-open carpal tunnel release has become increasingly popular for the treatment of carpal tunnel surgery. The main advantages are shortening recovery time and return-to-work time. However, the risk of neurovascular injury still remains worrisome. In this study, we developed a new retractor (herein called the PSU retractor) modified from the widely used Senn retractor, with the aim of decreasing the risk of neurovascular problems from normal procedure. 3-Dimensional computer design software (SolidWorksÂ® Office Premium 2007 SP3.1) was used to construct a 3-D PSU retractor prototype. An amputated arm from a 30-year-old woman diagnosed as synovial sarcoma at the shoulder was used to test the maximal visual length. A mini-surgical incision was performed at 3 cm distal to the transverse wrist crease and a tiny flexible ruler was inserted through the tunnel beneath the skin to measure the maximal visual length. Our new retractor showed significantly better maximal visual length compared to the Senn retractor (47.7(8.1) mm vs. 39.2(6.5) mm). In addition, most assessors expressed a higher satisfaction rate with the PSU retractor than with the Senn retractor (7.3

(1.9) vs. 6.3 (1.1)). In conclusion, we have developed a promising new retractor using a computer design program, which appears to be an improvement on the currently available equipment used for mini-open carpal tunnel surgery. However, further clinical studies are needed to confirm our initial findings.[35]

Yeo et al in 2007 published study on "Comparison of the results of open carpal tunnel release and Knife Light carpal tunnel release". The study compares the results of open release of carpal tunnel syndrome with a release done with a proprietary instrument, the Knife Light, which uses a minimal access approach. A retrospective study was conducted on two groups of patients operated on by the same surgeon between January 1998 and August 2002. All cases presented with numbness of six months duration or more, and a positive Phalen's test. Open carpal tunnel release was done in the first group of 26 consecutive patients before the Knife Light was introduced in January 2000. The Knife Light technique was used in a second consecutive group of 49 patients. In two patients, the Knife Light procedure was abandoned because the median nerve could not be safely separated from the transverse carpal ligament. The two groups were shown to be comparable with respect to clinical presentation and nerve conduction studies.[36]

Zyulk et al in 2006 conducted a randomised, controlled study was designed to compare the effectiveness of a single versus a double limited open technique of carpal tunnel release. Sixty-five patients (73 hands) with a mean age of 48 years were operated on, 40 hands by the single incision and 33 by the double incision method. Grip and pinch strengths, digital sensibility (Filament and 2PD tests) and Levine scores were evaluated throughout 12 months of follow-up. We found that the single incision method offers better results in respect of grip and pinch strengths: less weakness at 1 month after surgery and a faster improvement relative to pre-operative values which is statistically significant. This, however, did

not translate directly into Levine functional and symptom scores which, at each assessment, did not differ significantly between the two methods.[37]

Seigmeth et al in 2006 conducted a study on forty-two patients with bilateral idiopathic carpal tunnel syndrome (84 hands). The patients were randomized to determine which hand was to have carpal tunnel decompression using a technique that would try to preserve the superficial nerve branches. The other hand had open carpal tunnel decompression without any attempt to preserve the superficial nerve branches. An assessment of each hand in each patient was performed immediately before surgery and at 6 weeks, 3 months, and 6 months after surgery. This assessment was performed with a questionnaire based on the Patient Evaluation Measure. Scar pain scores in this series of open carpal tunnel decompressions were similar, whether or not an attempt was made to identify and preserve superficial nerve branches crossing the wound.[38]

Cellocco et al in 2005 published study on "Mini-open blind procedure versus limited open technique for carpal tunnel release: a 30-month follow-up study". To evaluate prospectively the safety and effectiveness of a mini-open blind technique for carpal tunnel release (group A) when compared with a limited open technique (group B). From November 1999 to May 2001 (mean follow-up period, 30 mo) we performed 222 carpal tunnel release procedures on 185 consecutive patients. All patients were affected by mild to moderate median nerve compression. Patients in group A (82 patients, 99 procedures) had a short transverse incision at the wrist (length, 2 cm). We used a manual surgical instrument that helps in blindly dividing the flexor retinaculum because it has an integrated light source. The light makes it possible to locate precisely the tool blade by transillumination. Patients in group B (103 patients, 123 procedures) had a limited longitudinal incision (length, 3-4 cm). The preoperative and postoperative patient statuses were evaluated with an Italian modified version of the Boston Carpal Tunnel questionnaire with a mean of 30

months' follow-up after surgery (range, 24-39 mo). Group A patients showed better results than group B patients in all of the sections of the Italian modified version of the Boston Carpal Tunnel questionnaire at a mean follow-up period of 19 months, whereas after a mean of 30 months of follow-up evaluation the differences between groups A and B tended to decrease. Disease recurred in 7 group B patients, whereas only 1 patient in group A experienced symptom recurrence at the latest office evaluation. The blind mini-invasive technique has been shown to be as safe as traditional techniques but the recovery period is significantly shortened. With the technique we described a low recurrence rate was observed. All patients in group A reported great reduction in preoperative pain and numbness.[39]

Klein et al in 2003 conducted a study to evaluate the safety and functional outcomes of minimal-incision open carpal tunnel release. In this prospective study involving a 2-year period, 104 patients (149 hands) underwent open carpal tunnel release with a 1-cm incision. Prospective data on complications among 104 patients were recorded, and functional outcomes among 20 patients were assessed by using the Michigan Hand Outcomes Questionnaire, the Jebsen-Taylor Hand Function Test, and pinch/grip strength testing. Data were collected before the operation and 3 weeks and 6 months after the operation. Complications included three wound infections and one carpal tunnel syndrome recurrence, 18 months after the initial release procedure. Michigan Hand Outcomes Questionnaire scores improved significantly between the preoperative and postoperative periods. There were no significant changes in Jebsen-Taylor Hand Function Test results or pinch/grip strength. Minimal-incision open carpal tunnel release can be performed safely and is associated with good functional outcomes.[40]

Gerritesen et al in 2001 did computer aided researches of Medline, EMBASE and the Cochrane Controlled Trials Register and concluded that standard OCTR is still the preferred method of treatment for CTS. It is just

as effective as the alternatives, but is technically less demanding, so incurs a lower risk of complications and of added costs.[41]

Bromley et al in 1994 in his procedure provided a direct visualization of the carpal ligament and median nerve using a small palmar incision. Postoperative discomfort and scarring were diminished. The small dressing, without splinting, permits rapid return to usual daily activities, and time lost from work is minimized. For those who regard endoscopic decompression as a "blind" procedure, this technique provides for a direct approach with minimal morbidity.[42]

MATERIALS AND METHODS

SOURCE OF DATA

The purpose of this study is to review and analyse the outcome of procedure. Study is based on a retrospective and prospective review of the medical records of all cases of CTS who had undergone Mini-Incision Release between January 2017 and June 2019 at Dayanand Medical college Hospital, Ludhiana. Patients were followed up monthly by clinical examination and final assessment was made 6 months after surgery whichever is later.

METHOD OF COLLECTION OF DATA

Study is based on a retrospective and prospective review of the medical records of all cases of CTS who had undergone Mini- Incision release between January 2017 and June 2019 at Dayanand Medical college Hospital, Ludhiana.

INCLUSION CRITERIA:-

Age group 18 to 70 years of either sexes.

Carpal tunnel syndrome according to classification Confirmed by clinical examination, and if required NCS /EMG.

Patients who give informed consent and willing for follow up.

EXCLUSION CRITERIA:-

Patients having CTS with non-operative management

Patients less than 18 years of age.

Patients unfit for surgery.

Pregnancy.

Associated comorbid conditions -Major psychiatric illness

Pre-Operative Regimen

A detailed history will be taken from the patient presenting to the hospital emergency or the department. He/ She will undergo complete physical examination. All other systems will also be assessed and managed by respective departments. Routine investigations as per protocol. Any coexisting comorbidities such as diabetes mellitus, smoking, steroid use,

alcoholism, old age will also be taken into account and recorded. Pre anaesthetic check-up and consultation from suitable department will be taken or any coexisting comorbidity. Patients will be taken up for surgery after clearance from the respective department and Anaesthesia team.

Preparation in the OT

Patient will be placed on OT table and positioned in supine position. Patient will be administered suitable anesthesia (LA/block/GA/Regional) by the anesthesia team. The cleaning will be done using 10% Povidone Iodine and draped using all sterile precautions.

Operative Procedure:

The mini incision technique will be performed after local anesthesia with an upper- arm pneumatic tourniquet/GA/BLOCK. The 1-cm first incision will be marked in the palm, beginning at the intersection of Kaplan's cardinal line and a line drawn along the radial border of the third web. The 1.5 cm second skin incision will be made on a line between palmaris longus and the flexor carpi ulnaris tendons. After the first skin incision, the subcutaneous tissue will be incised with a no. 15 blade and two retractors will be positioned to separate the edges of the incision. The palmar fascia will be divided by blunt dissections. The distal edge of flexor retinaculum and median nerve will be visualized. After the second skin incision made at the wrist level, the proximal edge of the flexor retinaculum and median nerve will be identified. A long nasal speculum will then be pushed proximally from the first incision to the second incision and introduced between the palmar fascia and the transverse carpal ligament. Anasal septum knife (Ballenger) will then be gently pushed distally to divide the flexor retinaculum. The flexor retinaculum between the blade and handle will be completely incised under direct vision.

The incisions will be closed with interrupted 4-0 nylon sutures and a pressure bandage will be applied. The tourniquet will be then released. No splint will be used, and the patients will be encouraged to move their hands and fingers in the immediate postoperative period. The original

dressing will be removed after 5 days, and the stitches will be removed after 10 days.

Post-operative Regimen

Patient will undergo appropriate physiotherapy in the form of exercises, once the patient is pain free. IV antibiotics and IV analgesics will continue as required for soft tissue healing. After the patient is discharged from the hospital, he will be on regular follow up and assessment of progress.

Immediate Postoperative Rehabilitation

The surgical site is injected with 2.0 cc of 0.5%Marcaine immediately after closing the skin, for pain reduction, and the surgical wound is dressed with a sterile pad and a soft gauze wrap,with some compression. The tourniquet is released only after the dressings are applied. Splints are not used as we have found them to cause secondary soft-tissue tightness that can restrict wrist motion and in some cases adherence of the median nerve in the surgical area. The dressings are examined before patients leave the hospital and loosened or redressed, as necessary, to avoid constriction, which we have found to be a common cause of postoperative discomfort. Patients are given a prescription for pain medication but they are encouraged to try to achieve a satisfactory level of comfort from a nonprescription pain reliever such as ibuprofen or aspirin. On the day after surgery patients are started in a physical therapy program of gentle range-of-motion exercises for the hand, wrist, and elbow and specific exercises to promote gliding of the median nerve through the surgical area. Patients are also instructed in a self-administered home program of edema control, wound care, nerve gliding exercises, and range-of-motion exercises for the wrist and hand. Following the first visit to physical therapy, patients are seen every 2 - 4 days to monitor progress and to advance postoperative rehabilitation. When discomfort from a surgical incision inhibits active use of the hand, a program of sterile whirlpool and assisted stretching exercises is used to improve range of motion and to facilitate wound healing. Gradually-progressive strengthening exercises are instituted

approximately 3–5 days after surgery, along with incorporating these exercises into the self-administered home care routine. Surgical sutures need not to be removed as applied subcutaneously and subcuticular. Ultrasound and soft tissue mobilization techniques are administered to the proximal palm if pillar pain is present. Patients are monitored closely to assess progress in range of motion, strength, and level of comfort. Occupational requirements are evaluated frequently. Patients are released to gainful employment when it is felt that strength, range of motion, and hand comfort have increased to a level where modified or regular work can be performed comfortably and safely.

Assessment of complications.

Peroperative – hand or wrist pain ,numbness at hand/ fingers, weakness in hand or wrist , tingling sensations, difficulty with grasping Late post-operative - Patients will be analyzed for any complications such as infection,scar formation, weakness in hand or wrist. The patient shall be under follow up till 6 months post-surgery.

DURATION OF STUDY

The purpose of this study is to review and analyse the outcome of procedure. Study would be based on a retrospective and prospective review of the medical records of all cases of CTS who will undergo MINI-INCISION RELEASE between January 2017 and June 2019 at Dayanand Medical college Hospital, Ludhiana.

OUTCOME

Final functional outcome at six months follow up using Boston carpal Tunnel syndrome Questionnaire.

STATISTICAL ANALYSIS

The data collected will be recorded in a proforma and will be analysed using appropriate observational statistical methods.

GLOBAL SYMPTOM SEVERITY SCORE

GSS SCORE	0	3	5	7	10
PAIN	none	mild	occasional	with fatigue/ work	continuous/ severe
NUMBNESS	NORMAL	SLIGHT	MEDIUM	SEVERE	VERY SERIOUS
PARAESTHESIA	NORMAL	SLIGHT	MEDIUM	SEVERE	VERY SERIOUS
WEAKNESS	NORMAL	SLIGHT	MEDIUM	SEVERE	VERY SERIOUS
NOCTURNAL AWAKENING	NONE	ONCE IN 2 WEEKS	2-3 TIMES IN 2 WEEK	4-5 TIMES IN 2 WEEKS.	> 5 TIMES IN 2 WEEKS

VISUAL ANALOG PATIENT SATISFACTION SCORE

VAGUSS	0	1	2	3
PALMAR TENDERNESS	severe/constant	moderate	mild	normal
SCAR SENSTIVITY	continuos/severe	moderate	mild/occasional	healthy scar
RETURN TO ACTIVITY	unable to return	within 21-30 days	11- 20 days	0-10 days
COSMETIC RESULT	swelling / infection	discharge /sinus	contour irregular	fully healed/ healthy scar

BOSTON CARPEL TUNNEL QUESTIONNAIRE

BOSTON					
ACTIVITY	No difficulty	Mild	Moderate	Severe	Cannot do
WRITING	1	2	3	4	5
BUTTONING CLOTHES	1	2	3	4	5
HOLDING BOOK	1	2	3	4	5
GRIPPING PHONE	1	2	3	4	5
HOUSEHOLD WORK	1	2	3	4	5
OPENING JAR/ GLASS	1	2	3	4	5
CARRYING BAGS	1	2	3	4	5
BATHING & DRESSING	1	2	3	4	5

OBSERVATIONS AND RESULTS

TABLE 1: AGE INCIDENCE

AGE	No. of cases	Percentage
< 40	9	22.0%
41-50	14	34.1%
51-60	11	26.8%
> 60	7	17.1%
Total	41	100.0%

It was observed in our study that carpal tunnel syndrome is more common in mean age of 49.22 ± 11.66 years. It is less common in young people with only 9 patients(22%) less than 40 years of age , 14 patients (34.1 %) were in the 41-50 age range , 11 patients (26.8 %) were in the 51-60 age range, 7 patients (17.1 %) were in the 61-70 age range.

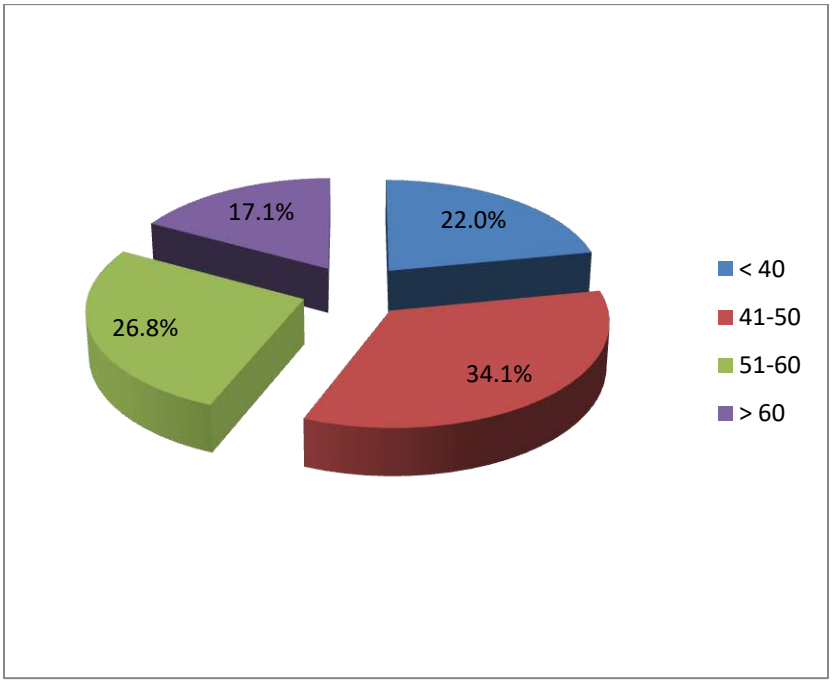

Figure 1: AGE DISTRIBUTION (YEARS)

Table 2: SEX INCIDENCE

SEX	No. of cases	Percentage
Female	29	70.7%
Male	12	29.3%
Total	41	100.0%

There were 29 (70.7%) females and 12 (29.3%) males and female to male ratio 2.41

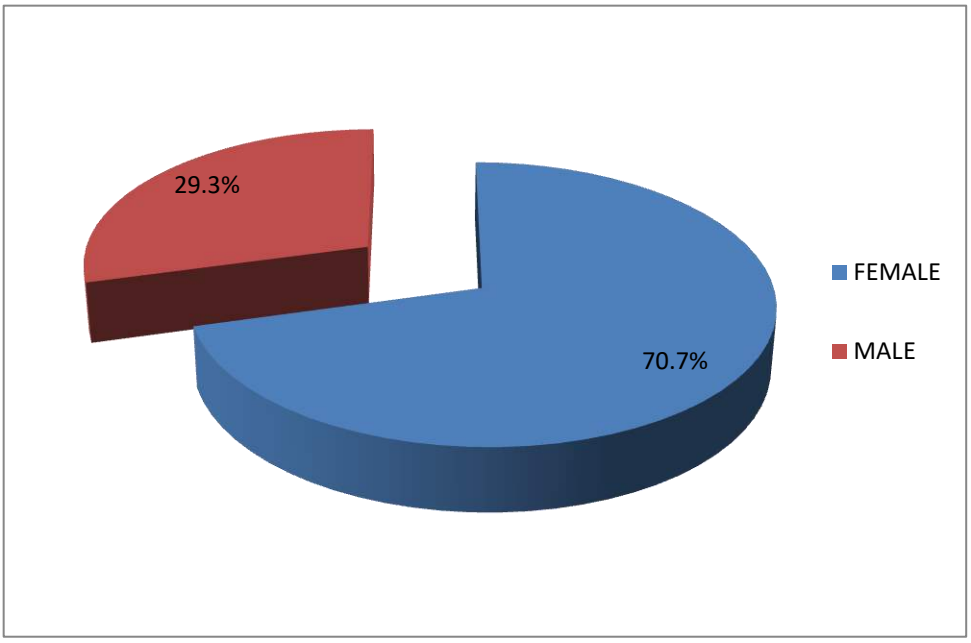

Figure 2: SEX INCIDENCE

Table 3: OCCUPATION

OCCUPATION	No. of cases	Percentage
Agriculture	5	12.2%
Dependent	21	51.2%
Employed	5	12.2%
Housewife	10	24.4%
Total	41	100.0%

Majority of patients in the study were dependent on other family members due to old age. 2nd majority of patient were housewives.

5 patients (12.2%) were in Agriculture as their occupation, 5 Patients (12.2%) were employed or in service, 21 patients (51.2%) were not working and were dependent and 10 patients (24.4%) were housewives. Majority of patients 31 (75.6%) were not working/ unemployed and only 10 patients (24.4%) were employed or working.

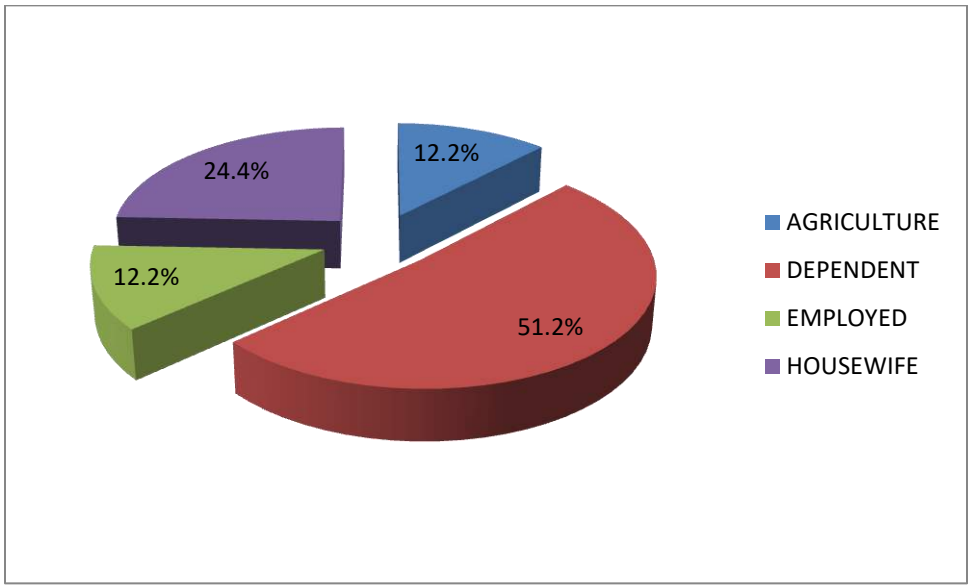

Figure 3: OCCUPATION

Table 4: SIDE OPERATED (LEFT/ RIGHT / BILATERAL)

Side	No. of cases	Percentage
Left	16	39.0%
Right	21	51.2%
Bilateral	4	9.8%

A total of 21 operations (51.2%) were performed for the right hand and 16 for the left (39%) hand. And 4 cases for bilateral hands (9.8%)

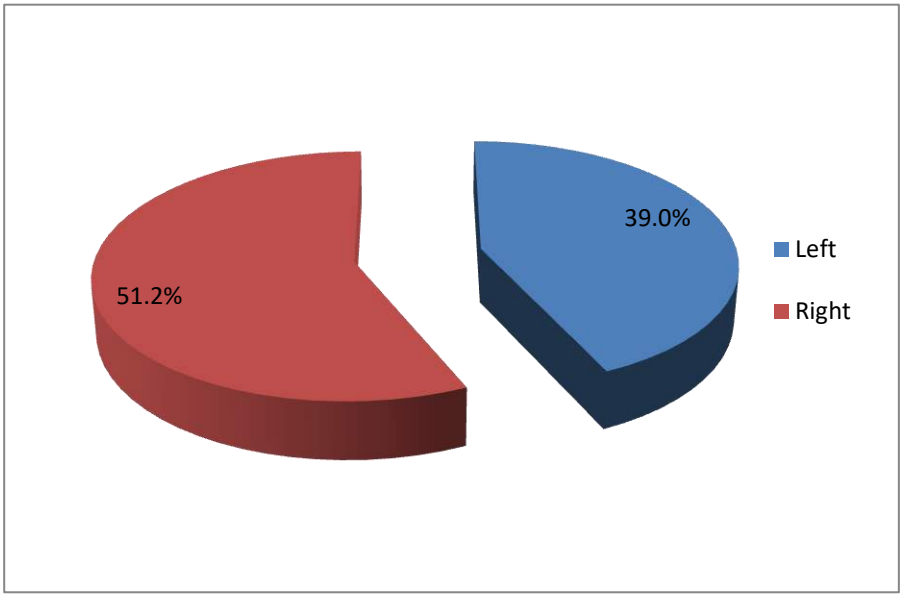

Figure 4: SIDE OPERATED (LEFT/ RIGHT / BILATERAL)

Figure 5: DURATION OF SYMPTOMS

DURATION OF SYMPTOMS	No. of cases	Percentage
< 6 month	10	24.4%
< 2 years	17	41.5%
> 2 years	14	34.1%
Total	41	100.0%

Only 10 patients (24.4%) had duration of symptoms for less than 6 months. Majority of patients 17 (41.5%) had duration of symptoms for 6-12 months and 14 patients (34.1%) had duration of symptoms for more than 2 years.

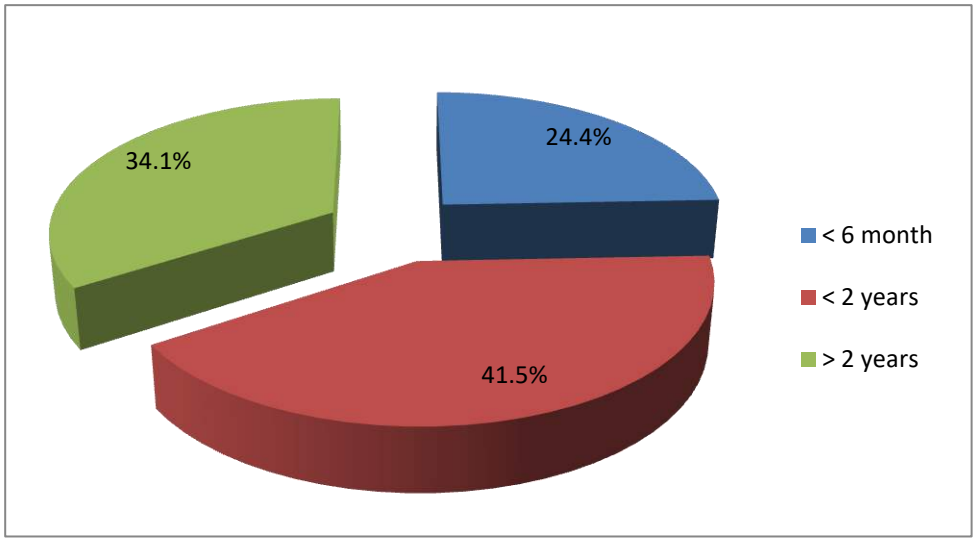

Figure 5: DURATION OF SYMPTOMS

Table 6: CLINICAL SIGNS

CLINICAL SIGNS	No. of cases	Percentage
Phalen sign	35	85.4%
Tinel sign	34	82.9%
Thenar atrophy	19	46.3%
Apb weaknes	33	80.5%

In majority of patients phalen test and tinel test were positive. In elderly patient's thenar atrophy and abductor pollicis brevis weakness was common.

Pre operatively, 35 patients (85.4%) were positive for Phalen test, 34 patients (82.9%) were tested positive for Tinel sign , 19 patients(46.3%) were had Thenar atrophy and 33 patients (80.5%) had abductor pollicis brevis weakness.

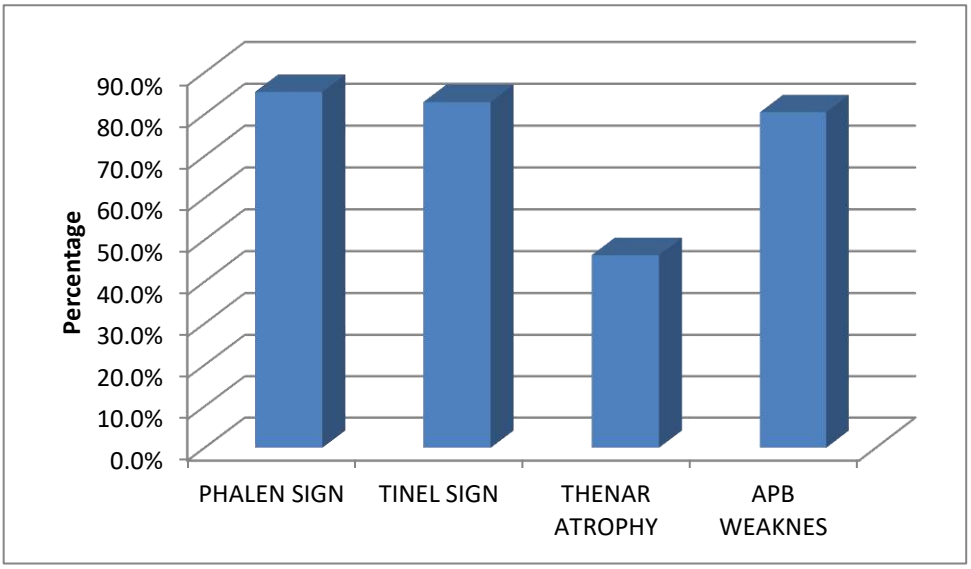

Figure 6: CLINICAL SIGNS

Table 7: COMORBIDITIES

COMORBIDITIES	No. of cases	Percentage
HTN	16	39.0%
DM	14	34.1%
Hypothroid	7	17.1%
Migraine	2	4.9%
Cerical spondylosis	2	4.9%
RA	1	2.4%
CAD	1	2.4%

16 patients (39%) were hypertensive, 14 patients(34.1%) were Diabetic, 7 patients(17.1%) were hypothyroid, 2 patients(4.9%) had migraine, 2 patients (4.9%) had cervical spondylosis, 1 patient(2.4%)had rheumatoid arthritis and 1 patient(2.4%) with CAD

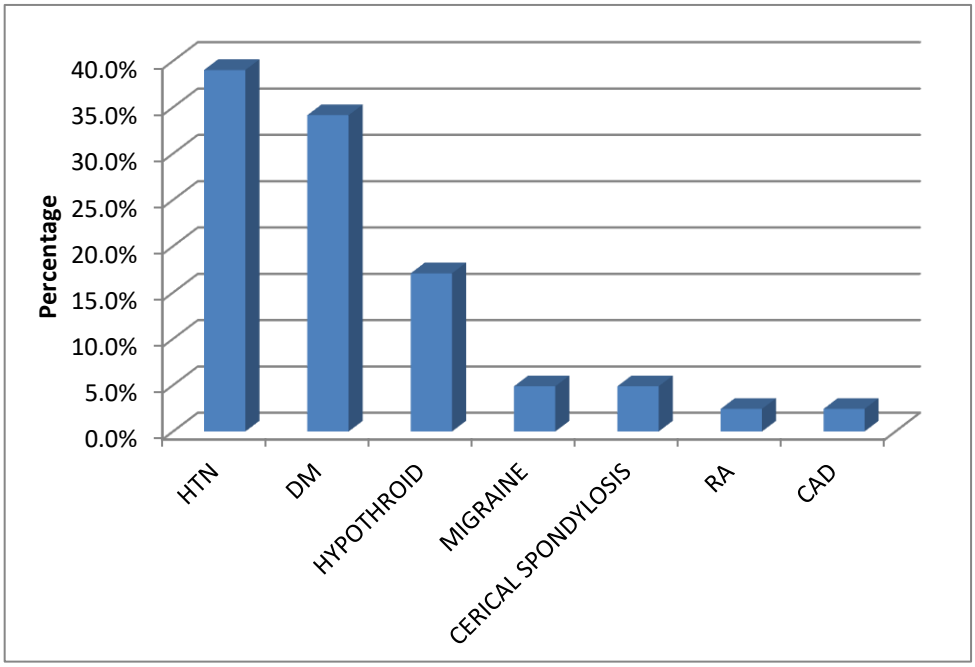

Figure 7: COMORBIDITIES

Table 8: TYPE OF ANAESTHESIA USED

ANAESTHESIA USED	No. of cases	Percentage
Block	5	12.2%
Local	32	78.0%
Short ga	4	9.8%
Total	41	100.0%

Majority of patients- 32(78%) were operated under Local Anaesthesia, 5 patients (12.2%) under supraclavicular block and 4 patients (9.8%) under SHORT GA.

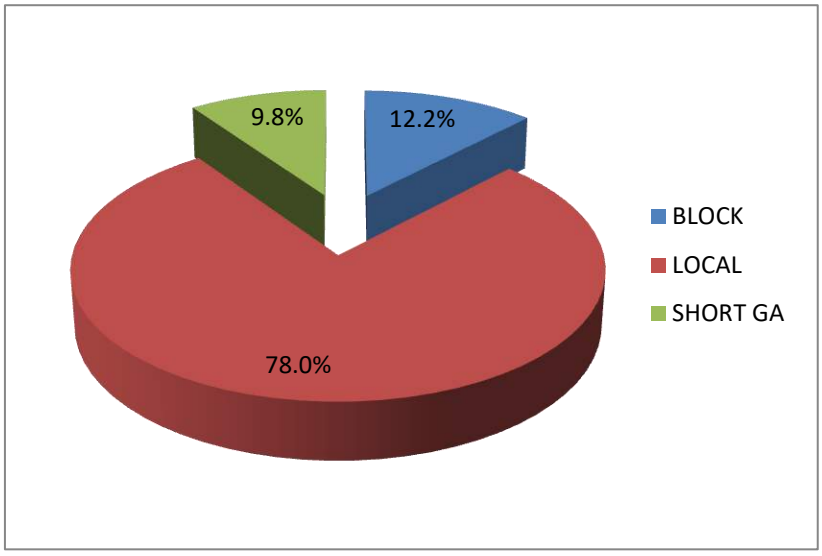

Figure 8: TYPE OF ANAESTHESIA USED

Table 9: VISUAL ANALOG PATIENT SATISFACTION SCORE

PALMAR TENDERNESS	No. of cases	Percentage
0 (severe/constant)	3	7.3%
1(moderate)	4	9.8%
2(mild)	4	9.8%
3(normal)	30	73.2%
total	41	100.0%

PALMAR TENDERNESS SCORE (0- 3)

Post operatively, 30 patients (73.2%) had palmar tenderness score of 3 suggesting there was no palmar tenderness, 4 patients (9.8%) had palmar tenderness score of 2 suggesting there was mild palmar tenderness, 4 patients (9.8%) had palmar tenderness score of 1 suggesting there was pain after doing work, 3 patients (7.3%) had palmar tenderness score of 0 suggesting there was constant palmar tenderness.

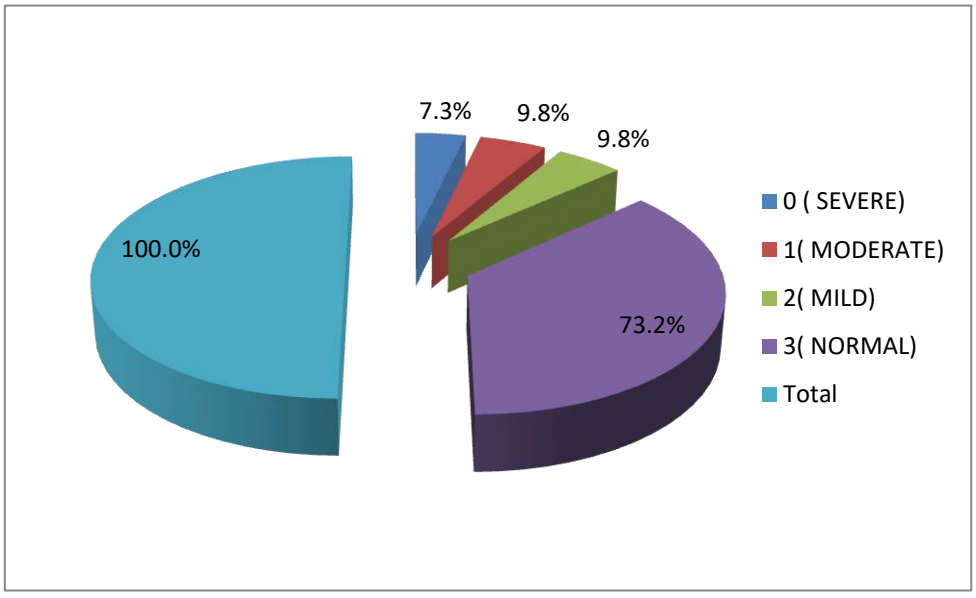

Figure 9: VISUAL ANALOG PATIENT SATISFACTION SCORE

Table 10: SCAR SENSITIVITY SCORE (0- 3)

SCAR SENSTIVITY	No. of cases	Percentage
0(continues/severe)	2	4.9%
1(moderate)	4	9.8%
2(MILD/ OCCASIONAL)	10	24.4%
3(HEALTHY SCAR)	25	61.0%
Total	41	100.0%

Post operatively, 25 patients (61%) had scar sensitivity score of 3 suggesting there was no scar sensitivity and the scar mark was fully healthy, 10 patients (24.4%) had scar sensitivity score of 2 suggesting there was mild scar sensitivity/ occasional pain, 4 patients (9.8%) had scar sensitivity score of 1 suggesting there was pain after doing work, 2 patients (4.9%) had scar sensitivity score of 0 suggesting there was continues/constant scar pain.

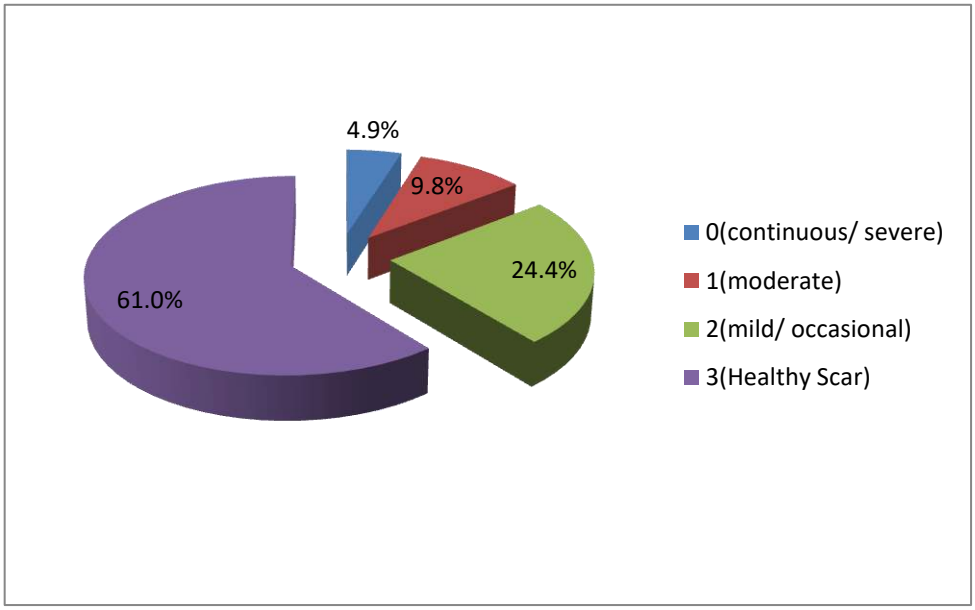

Figure 10: SCAR SENSITIVITY SCORE (0- 3)

Table 11: RETURN TO NORMAL ACTIVITIES (0 – 3)

RETURN TO ACTIVITY	No. of cases	Percentage
0**(** unable to do)	0	0.0%
1(21- 30 days)_	3	7.3%
2(11- 20 days)	9	22.0%
3(0-10 days)	29	70.7%
Total	41	100.0%

Post operatively Majority of patients 29 (70.7%) were able to returned to normal activities within 0-10 days post-operative, 22% of patients returned to activities within 11-20 days, 7.3 % of patients returned to activity within one month(21-30 days). Therefore, all 41 patients returned to activity within one month.

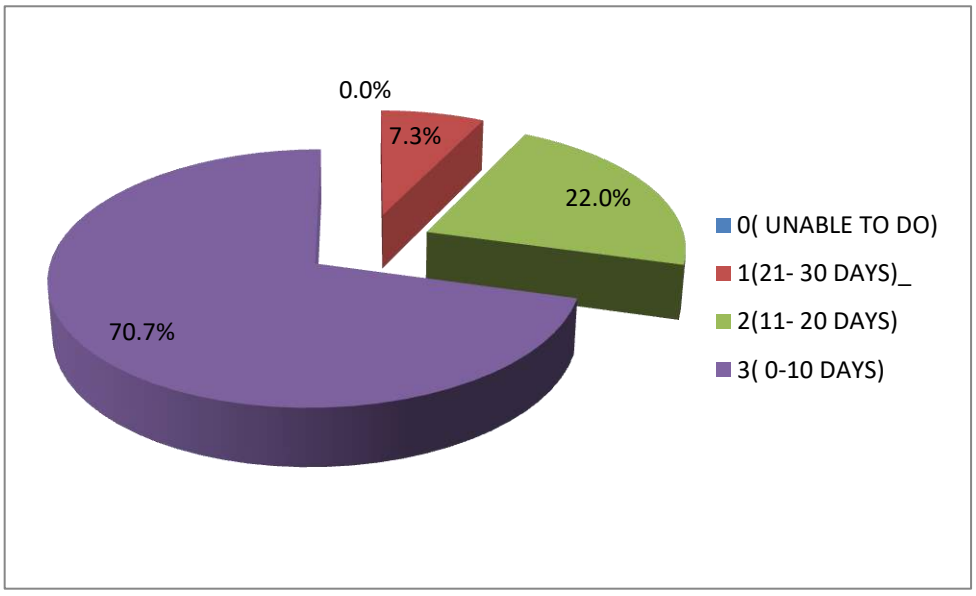

Figure 11: RETURN TO NORMAL ACTIVITIES (0 – 3)

Table 12: COSMETIC RESULT (0 -3)

COSMETIC RESULT	No. of cases	Percentage
0(swelling / infection)	0	0.0%
1(discharge /sinus)	0	0.0%
2(contour irregular)	5	12.2%
3(fully healed/ healthy scar)	36	87.8%
Total	41	100.0%

Cosmetic Result was assessed using Suture line score. Post operatively Majority of patients 87% had excellent cosmetic results with fully healed suture line and healthy scar. No patient reported with open wound with sinus/ discharge. 5 patients had irregular suture line with margins not properly opposed.

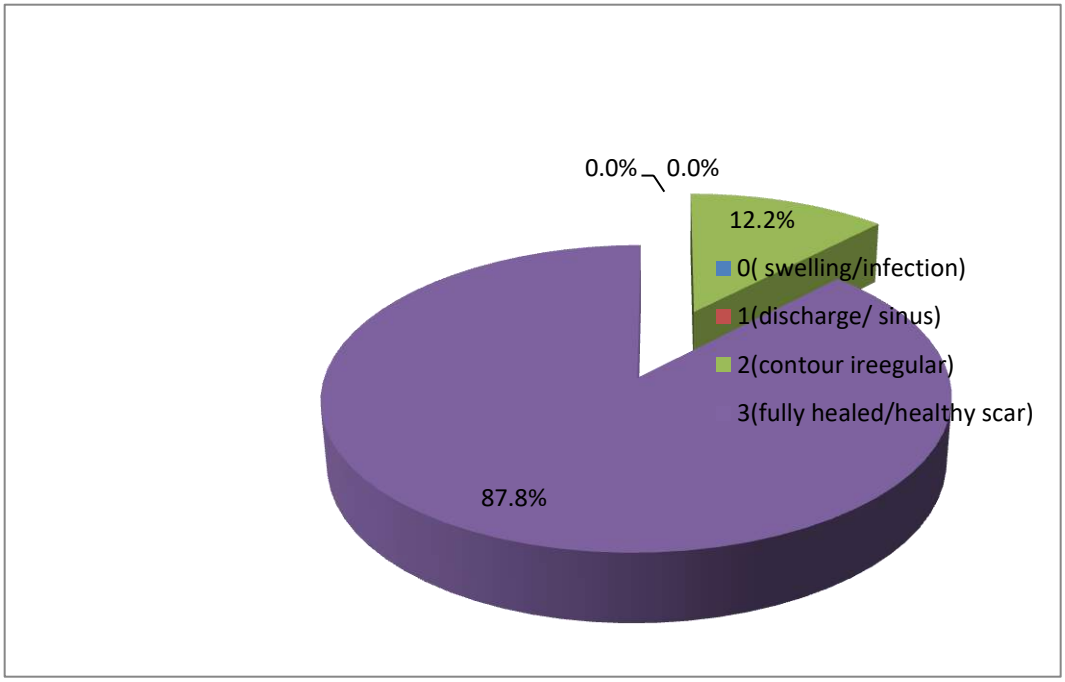

Figure 12: COSMETIC RESULT (0 -3)

Table 13: VISUAL ANALOG PATIENT SATISFACTION SCORE (VAGUSS)

VAGUSS	N	Minimum	Maximum	Mean	Std. Deviation
Palmar tenderness	41	0.00	3.00	2.49	0.95
Scar senstivity	41	0.00	3.00	2.41	0.87
Return to activity	41	1.00	3.00	2.63	0.62
Cosmetic result	41	2.00	3.00	2.88	0.33

Post operatively 41 patients had mean palmar senstitivity score of 2.49 ± 0.95 , mean scar sensitivity score of 2.41 ± 0.87, mean return to acitivity score was 2.63 ± 0.62 , and mean cosmetic result score was 2.88 ± 0.33

Table14: COMPLICATIONS OF MINI INCISION RELEASE INJURY

COMPLICATIONS	No. of cases	Percentage
Vascular injury	0	0%
Nerve injury	0	0%
Infection	0	0%
Flexor tendon injury	0	0%
Excessive bleeding	0	0%
Anaesthesia reaction	0	0%
Death	0	0%
No	41	100.0%
Total	41	100.0%

There was no evidence of any Intra operative complication like vascular injury, nerve injury, wound infection, flexor tendon injury. Excessive bleeding/ shock, hypersensivity reaction to anaesthesia or death.

There was no evidence of stiffness, loss of wrist strength, or recurrence of the disorder. Postoperative GSS scoring improved than preoperative

Table 15: PAIN COMPONENT

PAIN	No. of cases	Percentage
Fully Relieved/ Normal	26	63.4%
significant pain reduced	10	24.4%
Not Relieved	5	12.2%
Total	41	100.0%

Majority of patients (63.4% - 26) cases presented post operatively with full relief of pain 10 patients(24.4%) had significant reduction in pain post operatively 5 patients had no relief from pain and still had residual pain.

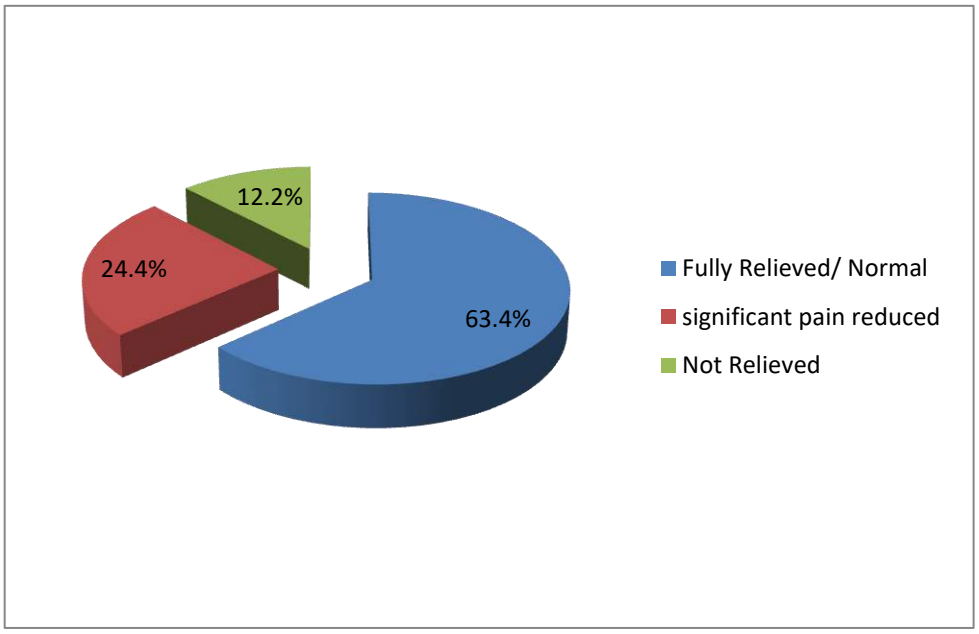

Figure 13: PAIN COMPONENT

Table 16: NUMBNESS COMPONENT

NUMBNESS	No. of cases	Percentage
Full relieved/ normal	32	78.0%
Significant relief	6	14.6%
No relief at all	3	7.4%
Total	41	100.0%

Majority of patients had full relief from numbness – 32 patients (78%) Only 7.4% patients (6) had no relief at all from numbness at hand/ wrist and had residual numbness.14.6% patients (6 cases) had significant decrease in numbness post operatively

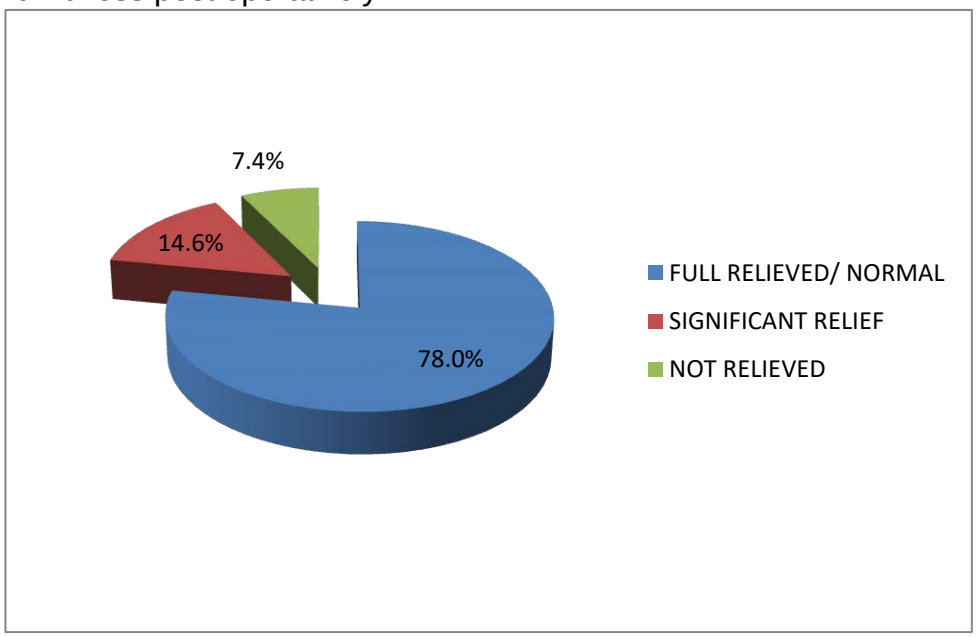

Figure 14: NUMBNESS COMPONENT

Table 17: PARAESTHESIA COMPONENT

PARAESTHSIA	No. of cases	Percentage
Recovered	33	80.5%
SIGNIFICANT Recovered	5	12.2%
NOT RELIEVED	3	7.3%
Total	41	100.0%

80.5% patients (33 cases) had full relief from paraesthesia and tingling sensation postoperatively only 7.3% patients had no relief from paraesthesia and tingling sensation after surgery 12.2% patients had significant decrease in numbness.

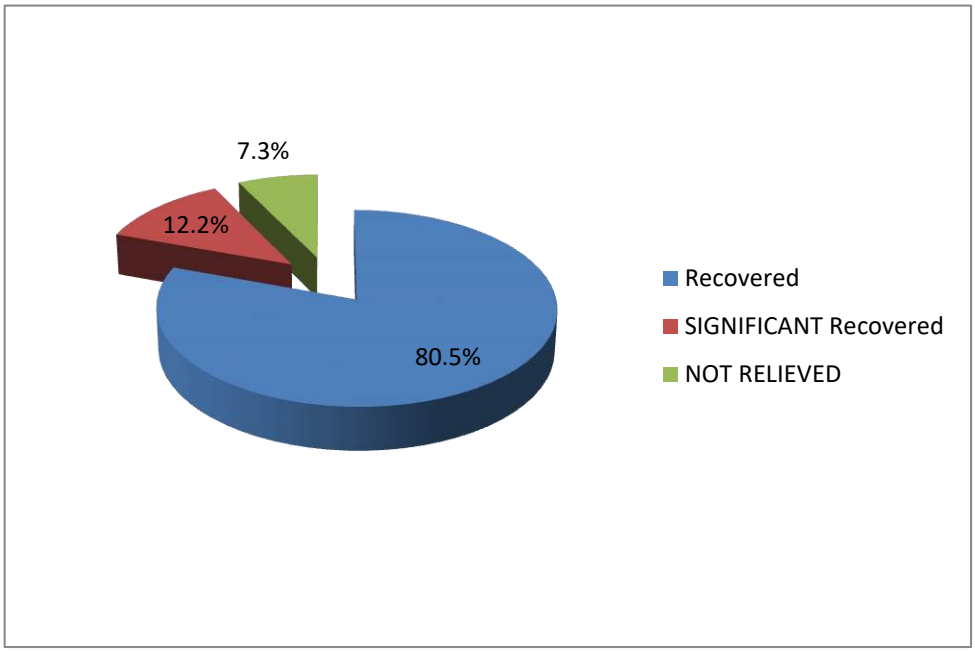

Figure 15: PARAESTHESIA COMPONENT

Table 18: WEAKNESS COMPONENT

WEAKNESS	No. of cases	Percentage
Recovered	30	73.2%
Significant recovered	6	14.6%
Still feel weakness	5	12.2%
Total	41	100.0%

73.2% had relief from weakness of hand, these patients showed increase in grip strength. 5 patients had no change in grip strength and still felt weakness 14.6% patients had significant reduction in weakness.

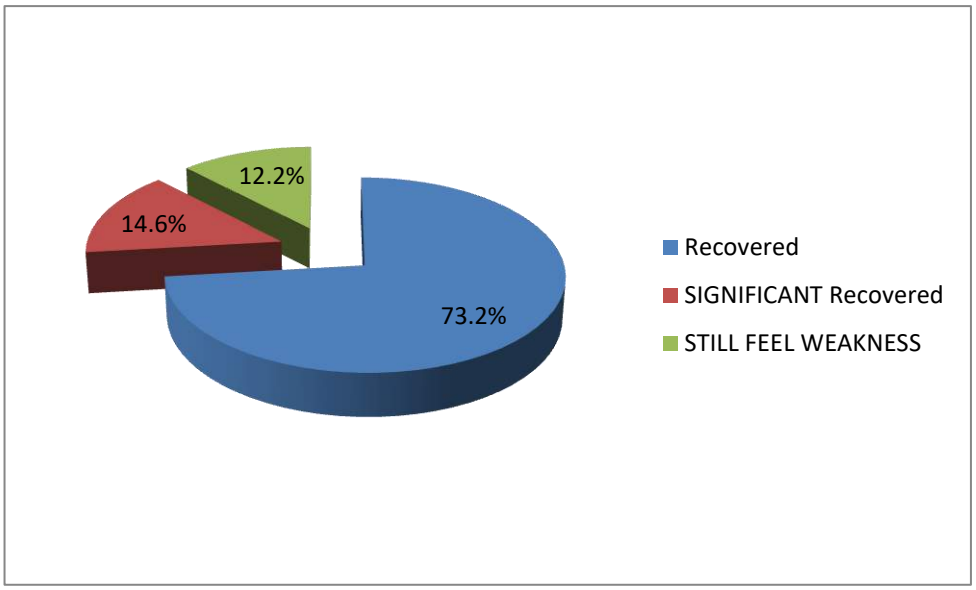

Figure 16: WEAKNESS COMPONENT

Table 19: NOCTURNAL AWAKENING

NOCTURNAL AWAKENING	No. of cases	Percentage
Recovered	29	70.7%
Significant Reduced	9	19.5%
Not Recovered	4	9.8%
Total	41	100.0%

70.7% patients (29 cases) had relief from episodes of nocturnal awakening due to pain and paresthesia .Only 4 patients (9.8%) did not recovered at all from nocturnal awakening episodes

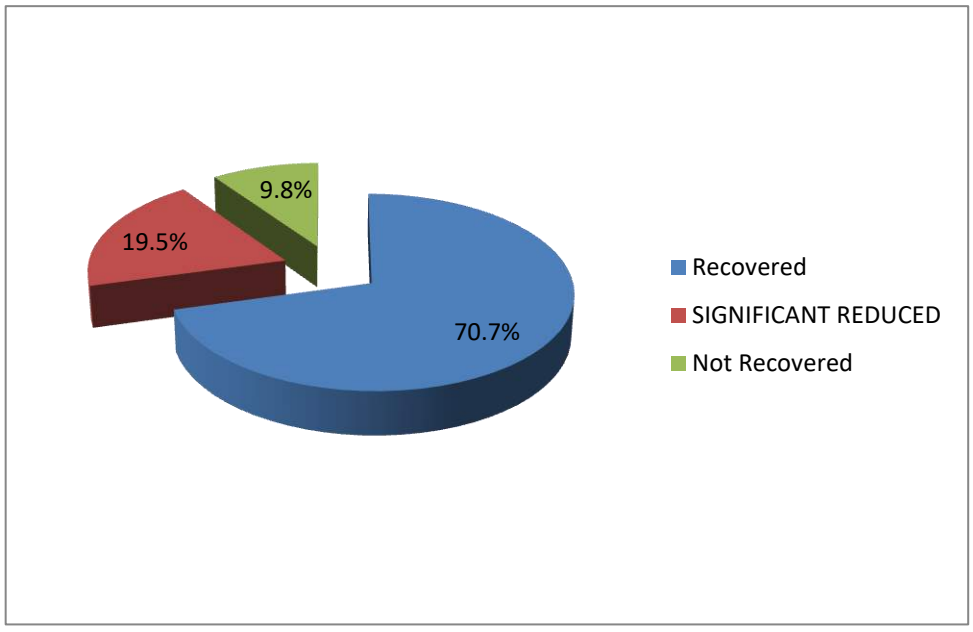

Figure 17: NOCTURNAL AWAKENING

Table 20: GSS – GLOBAL SYMPTOM SEVERITY SCORE

Pain mean score of all 41 patients pre operatively was 6.88 which decreased to 1.93 post operatively. Numbness mean score of all 41 patients pre operatively was 7.15 which decreased to 1.15 post operatively. Paraesthesia mean score pre operatively was 6.98 which decreased to 1.15 post operatively.

GSS score of all 41 patients- decreased from 33.44 to 7.17 post operatively.

COMPONENT	Pre op	Post- op
Pain	6.88 ± 2.25	1.93 ± 2.48
Numbness	7.15 ± 1.41	1.15 ± 1.90
Paraesthesia	6.98 ± 1.82	1.15 ± 1.80
Weakness	6.54 ± 2.34	1.51 ±2.13
Night awake	5.90 ± 2.65	1.44 ±2.13
Total	33.44 ± 6.75	7.17 ± 9.44

The Mean Average Pain score pre operartively is calculated to be 6.88 ± 2.25 which decreased to 1.93 ± 2.48 post operatively. This shows that there is significant decrease in pain in patients post operatively carpal tunnel release surgery

The Mean Average Numbness score pre operatively is calculated to be 7.15 ± 1.41 which decreased to 1.15 ± 1.90 post operatively. This shows that post operatively patients gained sensation at the hand and wrist which was previously numb.

The Mean Average Paraesthesia score pre operatively is calculated to be 6.98 ± 1.82 which decreased to 1.15 ± 1.80 post operatively. This shows significant reduction in paraesthesia and Tingling sensation in patient after Mini Incision Carpal tunnel release Surgery.

The Mean Average Weakness /Grip Strength score pre operatively is calculated to be 6.54 ± 2.34 which decreased to 1.51± 2.13 post operatively. This shows that there is significant decrease in weakness at hand/ wrist and increase in grip strength in patients post operatively carpal tunnel release surgery.

The Mean Average Nocturnal Awakening score pre operartively is calculated to be 5.90 ± 2.65 which decreased to 1.44± 2.13 post operatively. This shows that there is significant decrease in episodes of nocturnal awakening due to pain at hand, wrist and forerarm at night in patients post operatively carpal tunnel release surgery.

The mean preoperative GSS score was 33.44± 6.75 which decreased to 7.17 ± 2.44 postoperatively.

The Mean Average of 5 parameters – Pain, Numbness Parathesia, Weakness and Nocturnal Awakening calculated on score of (0-10). 0 means no symptom and 10 means worst symptom. The Mean Score of all parameters decreased from 33.44 to 7.17 post-operative mini incision carpal tunnel release surgery

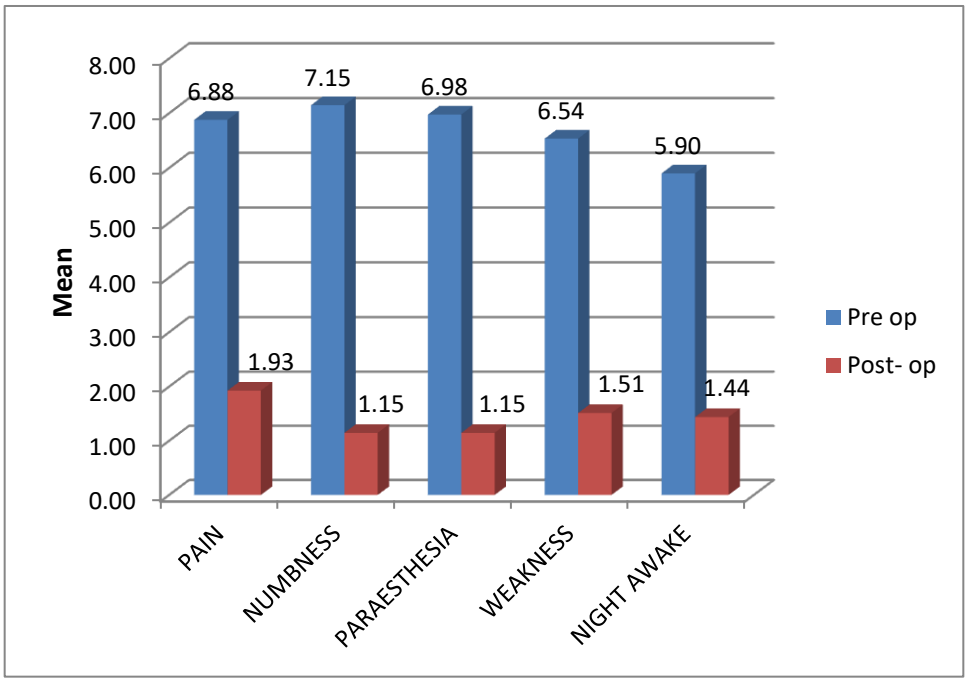

Figure 18 a: GSS – GLOBAL SYMPTOM SEVERITY SCORE

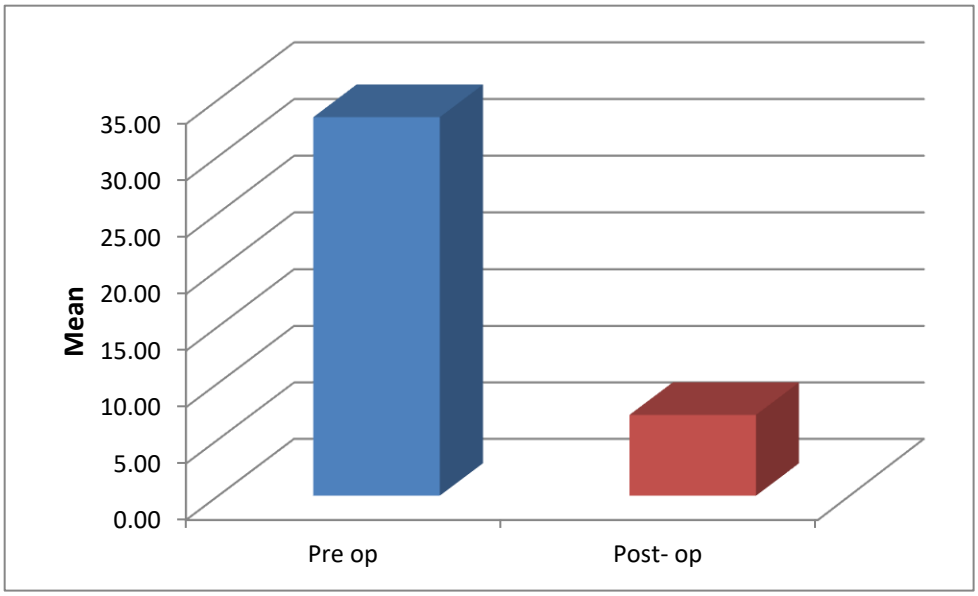

Figure 18 b: GSS – GLOBAL SYMPTOM SEVERITY SCORE

The mean preoperative GSS score was 33.44± 6.75 which improved to 7.17 ± 2.44 postoperatively.

Table 21: GLOBAL SYMPTOMS SCORE.

	Pre		Post		t	p-value	Difference	
	Mean	SD	Mean	SD			Mean	SD
Pain	6.88	2.25	1.93	2.48	12.390	0.000	4.95	2.56
Numbness	7.15	1.41	1.15	1.90	18.746	0.000	6.00	2.05
Paraesthesia	6.98	1.82	1.15	1.80	17.508	0.000	5.83	2.13
Weakness	6.54	2.34	1.51	2.13	13.107	0.000	5.02	2.45
Night awake	5.90	2.65	1.44	2.13	10.760	0.000	4.46	2.66
Total	33.44	6.75	7.17	9.44	20.032	0.000	26.27	8.40

The mean preoperative GSS score was 33.44± 6.75 which decreased to 7.17 ± 2.44 postoperatively.

Association of GSS score to post-operative outcome was found to be statistically significant (p=0.000)

Table 22: BOSTON CARPAL TUNNEL SYNDROME QUESTIONNAIRE (BCTQ)

BOSTON QUESTIONNAIRE	PreOP - FSS	PostOP- FSS
Writing	3.54	1.44
Buttoning clothes	3.32	1.41
Holding book	3.54	1.39
Gripping phone	3.37	1.39
Household work	3.83	1.80
Opening jar/ glass vial	3.68	1.85
Carrying bags	3.59	1.95
Bathing & dressing	3.44	1.65
Total score	28.29	11.44

The Boston questionnaire was employed, which also provided a standardization of those subjective outcomes, due to its reproducibility, coherence, validity and sensitiveness to clinical changes. Boston Functional status score- FSS score of wrting decrease from 3.54 to 1.44 in patients post operatively, mean score of household work decreased from 3.83 to 1.80. Mean score of market work carrying bags decreased from 3.44 to 1.65 .score of bathing and dressing decreased from 3.44 to 1.65. Score of holding book and gripping phone decreased from 3.54 to 1.39 and 3.37 to 1.39 respectively. Post operatively when the averages for each question were calculated, we found the highest scores concerning the functional status, activities related to strength (housekeeping, opening a glass vial cap and carry market bags).

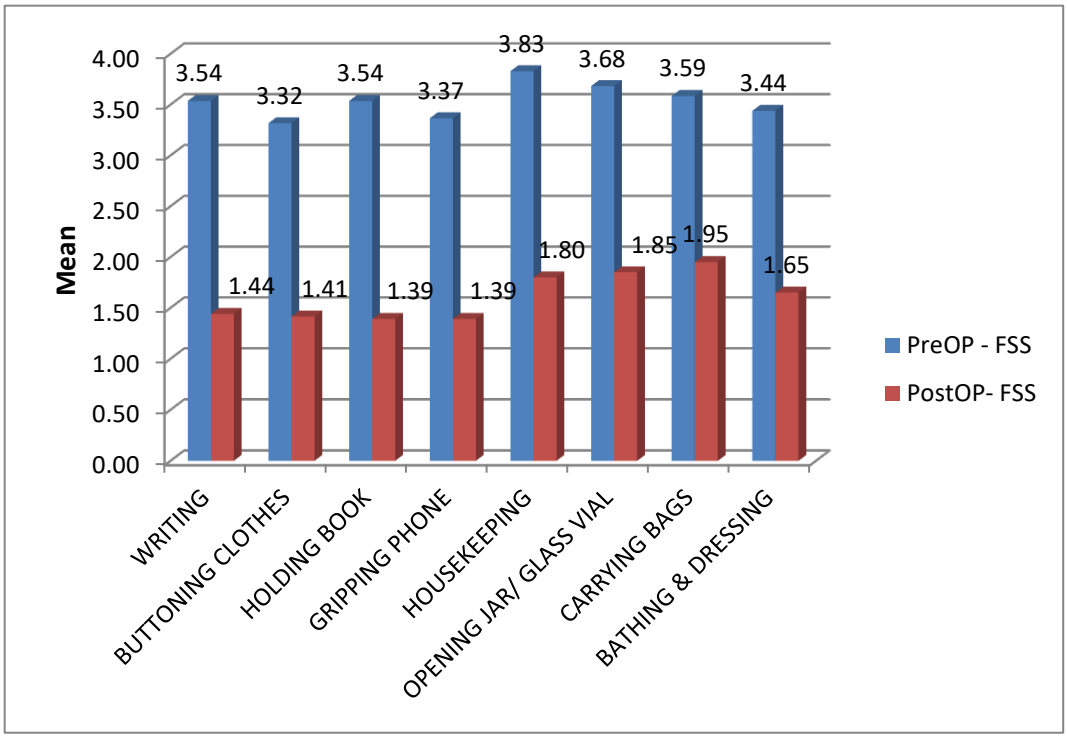

Figure 19: BOSTON CARPAL TUNNEL SYNDROME QUESTIONNAIRE (BCTQ)

Table 23: BOSTON CTS QUESTIONNAIRE RESULTS.

	Pre		Post		t	p-value	Difference	
Daily Tasks	Mean	SD	Mean	SD			Mean	SD
Writing	3.54	0.55	1.44	0.71	17.482	0.000	2.10	0.77
Buttioning clothes	3.32	0.65	1.41	0.71	14.662	0.000	1.90	0.83
Holding book	3.54	0.60	1.39	0.67	15.103	0.000	2.15	0.91
Holding phone	3.37	0.62	1.39	0.74	13.932	0.000	1.98	0.91
Opening of jars	3.83	0.74	1.56	0.84	16.757	0.000	2.27	0.87
Household work	3.68	0.79	1.44	0.74	15.686	0.000	2.24	0.92
Carrying market bags	3.59	0.71	1.44	0.78	13.236	0.000	2.15	1.04
Bathing and dressing	3.44	0.59	1.37	0.66	16.224	0.000	2.07	0.82
Total	28.29	3.40	11.44	5.38	18.693	0.000	16.85	5.77

The mean FSS- SCORE of 41 patients decreased from 28.99 to 11.44 post operatively after carpal tunnel release surgery. Patients had improvement in functional outcome of doing daily routine activities. Functional activity (writing, buttoning clothes, holding a book while reading, holding a telephone hang, house keeping, opening a glass vial cap, carrying market bags, bathing and dressing) improved significantly.

Association of FSS score to post-operative outcome was found to be statistically significant (p=0.000)

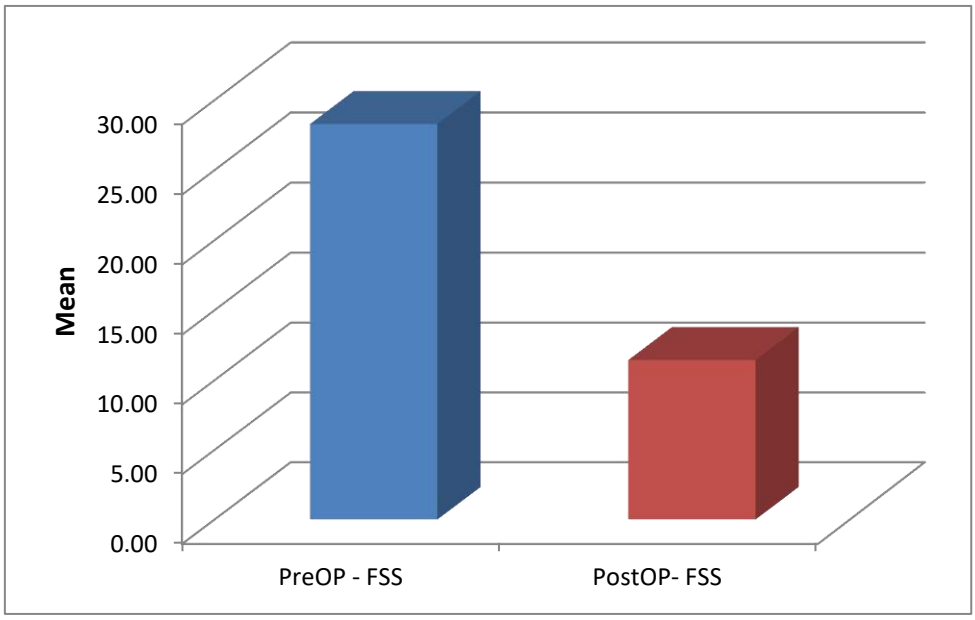

Figure 20: BOSTON CTS QUESTIONNAIRE RESULTS.

Table 24: HAND FUNCTION ACCORDING TO PATIENT (SATISFACTION SCORE)

SUBJECTIVE RESULT	No. of cases	Percentage
Excellent	23	56.1%
Good	10	24.4%
Fair	5	12.2%
Poor	3	7.3%
Total	41	100.0%

56.1% patients expressed excellent satisfaction after surgery and said that they would recommend this surgery to other patients. 24.4% patients were satisfied (good level). 5 patients expressed fair satisfaction and 3 patients were not satisfied at all after surgery.

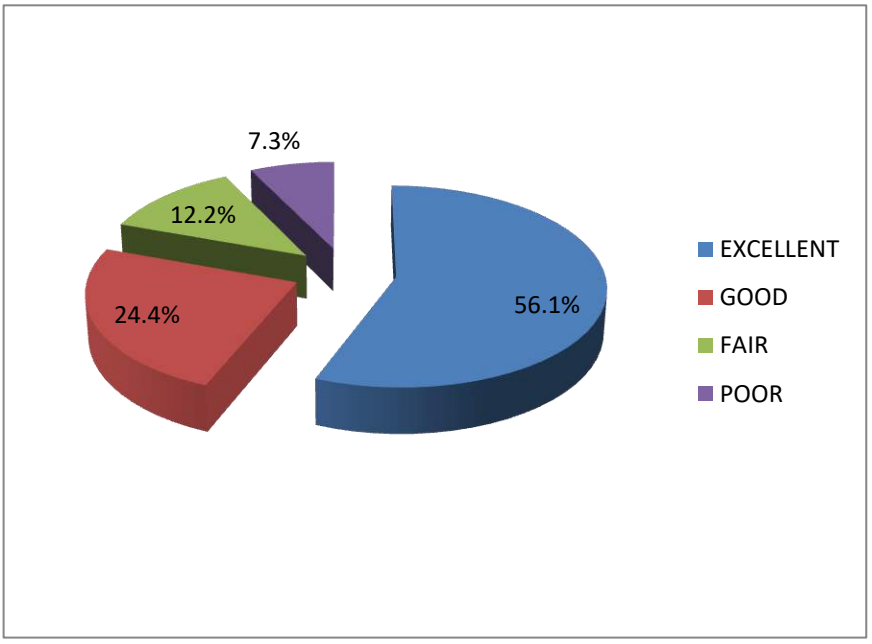

Figure 21: HAND FUNCTION ACCORDING TO PATIENT (SATISFACTION SCORE)

DISCUSSSION

The CTS is the most common compressive neuropathy in clinical practice. It is caused by the compression of the median nerve at the wrist, more precisely at the carpal tunnel. In our study, CTS was more frequent in women (70.7%) (female/male: 2.41) and in the right hand (51.2% +9.8%=61%)with a mean age of 49.22 ± 11.66 years .Age range of 41-50 years was most common(34.1% patients in our study) and 2nd majority was patients in age range of 51-60 years (26.8% in our study).Patients in old age range of (41-60 years) are involved with several comorbidities and are operated most in our study(26.8% +17.1%=43.9%).

Mardanpour K et al[23] reported a similar trend in study in which. There were 132 (70%) females and 56 (30%) males with a mean age of 40 ± 29.5 years (ranging from 24 to 73) and female to male: 2.36. A total of 178 operations were performed for the right hand and 122 for the left hand.

Increased body mass index (BMI), dominant hand are other factors associated with CTS. In our study Majority of patients were housewives (24.4%) who were in age range of 41-50 years (34.1 % patients).Housewives are involved in hard work at home which involves wrist. A strong familial susceptibility for CTS, related to inherited genetic characteristics and medical conditions exist. Right Hand was operated in majority of cases (51.2% right + 9.8% bilateral= 61% for Right hand). Right Hand being the dominant hand and involved in prolonged severe force through the wrist, high amounts of repetitive movements, prolonged extreme factors was involved more and operated more by the surgeon.

Scott Blumenthal et al[43] reported a study on 343 patients with CTS and his association with Co morbidities. Diabetes mellitus was also more common in older adults (36%) than middle-aged (22%, p=.04) or young patients (11%, p< .001).

Anbarasan A et al[44] reported a study of 36 patients, four cases had bilateral involvement, and 26 cases were on right hand and another 14 on the left hand. The evaluation of SSS score showed marked reduction of

mean preoperative SSS of 33.60 to mean postoperative SSS of 15.25, which signifies that the surgery was successful in reducing the patients' symptoms. Meanwhile, the mean for pre- and postoperative FSS score was 26.65 and 11.25, respectively. Thus, the FSS showed marked reduction statistically, which signifies that the surgery was successful in improving the hand function of the patients.

Pain component outcome- In our study majority of patients 63.4% - 26 cases presented post operatively with full relief of pain, 10 patients (24.4%) had significant reduction in pain post operatively, 5 patients had no relief from pain and still had residual pain khan aa et al[45] in this article stated that Out of 100 patients, 19 were males. The age ranged from 32 to 50 years with a mean of 39.29±3.99 years. The duration of symptoms was from 5 to 24 months. In the entire series patient functional outcome and satisfaction was 82% at 1 month, 94% at 3 months and 97% at 6 months.

Ghasemi M et al[46] showed that the prevalence of probable CTS was 14% in men and 8.9% in women. The prevalence of CTS in their study was higher than general population (1-5% in the general population and 6-15% in the industrial workers). It is likely that the greater number of men involved in physically demanding work place men at higher risk than women in industrial settings. Median nerve compression increase during flexion and extension movements of the digits and wrist.

Medical conditions related to the development of CTS include diabetes (34.1% patients in our study), hypertension (39% patients in our study), Hypothyroid (17.1% patients involved in our study), rheumatoid arthritis (2.4% cases in our study), osteoarthritis of the carpo-metacarpal joint of the thumb. 5% patients were associated with cervical spondylosis / radiculopathy. And 1 patient had Coronary artery disease.

Majority of patients 31 (75.6%) were not working/ unemployed and only 10 patients (24.4%) were employed or working. People who were unemployed were mostly in old age range and housewives.

Most common cause for patients getting operated for carpal tunnel syndrome was pain at hand, wrist and forearm. In our nearly 90 % patients had pain component. Painful paresthesias and burning pain (was present in 87% patients in our study) in the lateral half of the hand, predominantly in the three first fingers. Typically, the paresthesias are predominantly nocturnal. The patients also complain of anesthesia/ numbness (in 90% patients in our study) who got operated. As majority patients were in old age with comorbiodties patients presented with Thenar Atrophy (85% in our study). Patients also had abductor pollicis brevis weakness (85% patients in our study).

The clinical test items that had acceptable diagnostic validity with a "general" CTS classification were: Phalen's test and Tinel Sign.

Phalen test is a provocative test done in the OPD and was used in the diagnosis of CTS. 85.4% patients who got operated in our study has positive Phalen test preoperatively which was done in our DMCH orthoapedics OPD. Patients experienced pain, numbness in the area of median nerve distribution on wrist flexion. Phalen test found to be highly specific and sensitive in making diagnosis in our OPD which was co related with NCV studies further.

Korkmaz M et al[30] reported in this study of 38 patients that Phalen test was positive in 65.8% patients who undergo mini longitudinal incision carpal tunnel release surgery.

Tinel test was also done in OPD. 82.9 % patients in our study has positive Tinel Sign which means 82.9% patients experienced Tingling sensation and feeling of pin and needles on tapping on nerve in OPD.

Korkmaz M et al[30] published on his study on 38 patients that Tinel sign was positive in 57.9% patients who undergo surgery.

46. 3% patients in our study who got operated had thenar atrophy. The recurrent branch of the median nerve supplies the thenar muscles via the thenar branch. Therefore when theis compressed and the transmission impeded the mucsles atrophy over time. Loss of function is

typically due to the Abductor Pollicis Muscle which provides most of the bulk to the thenar eminence. Abductor pollicis brevis muscle weakness was found in 80.5% cases in our study.

Blumenthal S et al[43] Thenar atrophy was related to age, and was seen in 8% of the young group, 33% of the middle-aged group, and 59% of the elderly group. Older age groups were more likely to have thenar weakness.

Duration of symptoms- Patients got operated for surgery after taking medical conservative treatment for long time. Patients were initially managed with medicines, physiotheraphy and CTS splint. Patients who did not have benefit from conservative therapy were managed surgically. Therefore duration of symptoms prior to surgery was more than 6 months in 75.6% of cases. 14 patients (34.1%) were symptomatic since more than 2 years before they undergo surgery. Only 10 patients had surgery within 6months of the onset of symptoms.

Nancollas et al reported that the average duration of symptoms prior to surgery was 26.5 months (range 1 month to 25 years). Classical findings of CTS (Phalen, 1970) were recorded for all cases, numbness being the chief complaint in 52% of hands, and Tinel's and Phalen's signs were present in 66%. Associated medical conditions were present preand post-operatively in 21 of the patients, including hypertension in eight patients, osteoarthritis in seven, diabetes mellitus in three, and hypothyroidism and pregnancy in two.

Majority of patients- 32(78%) were operated under Local Anaesthesia. Local anaesthesia was given by Orthopaedic surgeon himself with 2% lignocaine. Local was given because it reduced anesthetic time, quicker recovery time, decreased postoperative nausea and vomiting, earlier recognition of complications, fewer hemodynamic changes and and short procedure time. Local anaesthesia was found to be very effective in pain management during surgery and post-operative.

22% patients (5 +4=9) were operated under Supraclavicular block and Short GA (12.2% + 9.8%). This was done by the Anaesthesia team after the PAC (Pre anaesthesia checkup) clearance. These patients were either not willing local anaesthesia, or they have medical issues. So supraclavicular block was given for prolonged effect of anaesthesia. Hospital stay time of these patients was bit longer as compared to patients done under Local. These patients were monitored post operatively by the Anaesthesia and Orthopaedics team and nursing staff in Ortho recovery. No adverse effect / complication was found post operatively.

18% patient had residual pain at 1 month post-operative follow-up, 6% at 3 months and 3% at 6 month follow-up.

Numbness component - majority of patients had full relief from numbness – 32 patients (78%), only 7.4% patients (6) had no relief at all from numbness at hand/ wrist and had residual numbness.

14.6% patients (6 cases) had significant decrease in numbness post operatively.

Klein RDL et al[40] reported in his study that all patients (n-104) presented with combination of symptoms including numbness, night symptoms, pain and tingling. After carpal tunnel release, majority of patients reported complete resolution of the symptoms. Only six patients had residual numbness and/ or pain 3 weeks post operatively, which persisted at the 6 month follow up examination for three patients.

Kulick et al[47] found that 81 % of patients had resolution of paresthesias 4 years after surgery. Of those which failed, six hands (4.6 %) had suffered recurrence and the remainder had persistent symptoms, including pain, median nerve paresthesia, and APB muscle involvement (atrophy and weakness). All hands had received a trial course of injected steroids prior to surgery.

Kouyoumdjian et al[48] received responses to a retrospective, unvalidated questionnaire from 114 open carpal tunnel release patients. The average follow-up time was 71 months, and the response rate was 34.8 %.

Patients self-ranked their own outcomes as follows: 77.6 % cured, 13.6 % much better, 5.4 % little improvement, 2.7 % unchanged, and 0.7 % worsened.

Haupt et al[49] assessed 86 hands a median of 5.5 years after surgery. Using EMG testing, they found that 86 % of cases demonstrated symptom resolution, but only 26 % had complete electrodiagnostic improvement. Seven percent had worsened from their baseline preoperative state.

Return to activity – In our study Post operatively Majority of patients 29 (70.7%) were able to return to normal activities within 0-10 days post operative, 22% of patients return to activites within 11-20 days **Sanati KA et al**[33] reported a study in which altogether, 15 RCTs with 1,512 patients and 1,688 hands were included. Results shows that minimally invasive carpal tunnel surgery offers significantly earlier return to work with mean average – 6 days.

Surgical treatment of CTS consists of the division of the transverse carpal ligament which reduces the pressure on the median nerve by increasing the space in the carpal tunnel. Many surgical techniques have been used to treat CTS such as the classical open carpal tunnel release technique, the “mini-open” or limited visualization techniques, and the endoscopic carpal tunnel release methods.

Post operatively outcome and evaluation of Mini Incision release surgery was done in Orthopaedics OPD of DMCH at regular follow ups using visual analog patient satisfaction score, gss – global symptom severity score, fss- functional status score.

Post operatively, 30 patients (73.2%) had palmar tenderness score of 3 which means there was no palmar tenderness, 25 patients (61%) had scar sensitivity score of 3 which means there was no scar sensitivity and the scar mark was fully healthy, 29 patients (70.7%) were able to return to normal activities within 0-10 days post-operative (score of 3), 87% patients has excellent cosmetic results with fully healed suture line and healthy scar with no hypertrophy.

In our study, the mean FSS- Score of 41 patients decreased from 28.99 to 11.44 post operatively after carpal tunnel release surgery. Patients had improvement in functional outcome of doing daily routine activities. The mean preoperative GSS score was 33.44± 6.75 which decreased to 7.17 ± 2.44 postoperatively in our study.

Korkmaz M et al[30] published in his study that Ninety three hands of 79 patients with CTS were operated. The mean pre-operative and postoperative BQ functional condition scores in Group-1(Mini longitudinal incision) patients were 29.5 ± 5.3 and 10.9 ± 2.5 ($p < 0.0001$) and as 31.5 ± 5.7 and 12.2 ± 2.3 ($p < 0.0001$) in Group-2(Mini Transverse Incision) patients respectively.

Nancollas et al[50] reported that Of the 60 wrists upon which operated, the results of 87% were judged by patients to be good to excellent overall.

Lia Miyamoto Meirelles1 et al[51] reported that by applying the Boston questionnaire, they found a functional status score (FSS) of 1.59 ± 0.93. In the analysis by question, the highest averages were found for symptoms severity in question functional status, in questions number 5, 6, and 7 (F5, F6 and F7).

56.1% patients expressed excellent satisfaction after surgery and said that they would recommend this surgery to other patients. 24.4% patients were satisfied (good level).

SUMMARY AND CONCLUSIONS

Carpal tunnel syndrome is the most common and most important of all the nerve entrapment syndromes.

More common in mean age of 49.22 ± 11.66 years 78% patients were more than 40 years of age and only 22% patients below 40years.

There were 29 (70.7%) females and 12 (29.3%) males and female to male ratio 2.41 Majority of patients 31 (75.6%) were not working/ unemployed and only 10 patients (24.4%) were employed or working.

10 patients (24.4%) were housewives

A total of 21 operations (51.2%) were performed for the right hand and 16 for the left (39%) hand. And 4 cases for bilateral hands (9.8%)

32 (78%) were operated under Local Anaesthesia, 5 patients (12.2%) under supraclavicular block and 4 patients (9.8%) under Short GA.

Majority of patients 17 (41.5%) had duration of symptoms for 6-12 months and 14 patients (34.1%) had duration of symptoms for more than 2 years.

35 patients (85.4%) were positive for Phalen test, 34 patients (82.9%) were tested positive for Tinel sign.

16 patients (39%) were hypertensive, 14 patients (34.1%) were Diabetic, 7 patients (17.1%) were hypothyroid.

Post-operative VAGUSS SCALE- Palmar tenderness mean score was 2.49 (no tenderness), scar sensitivity -2.41 (no sensitivity), return to acitivity was 2.63 (within 10 days) and cosmetic result was 2.88 (excellent).

There was no evidence of any Intra operative complication like vascular injury, nerve injury, wound infection, flexor tendon injury. Excessive bleeding/ shock, hypersensivity reaction to anaesthesia.

Majority of patients (63.4% - 26) cases presented post operatively with full relief of pain 10 patients (24.4%) had significant reduction in pain post operatively

Majority Of Patients Had Full Relief From Numbness – 32 Patients (78%), Only 7.4% Patients (3) Had No Relief At All From Numbness.

73.2% had relief from weakness of hand, these patients showed increase in grip strength.

GSS score of all 41 patients- decreased from 33.44 to 7.17 post operatively.

The mean FSS- SCORE of 41 patients decreased from 28.99 to 11.44 post operatively after carpal tunnel release surgery. Patients had improvement in functional outcome of doing daily routine activities.

56.1% patients expressed excellent satisfaction after surgery and said that they would recommend this surgery to other patients. 24.4% patients were satisfied (good level).

Mini-incision release for carpal tunnel syndrome release is a less invasive technique with minimal complications, shorter operative time, and more cost-effective. Results in less pain in the early postoperative period and a quicker return to work and less wound complications.

This study provides strong evidence that Mini Incision carpal tunnel release yields a similar large degree of symptom relief and improvement in health related quality of life.

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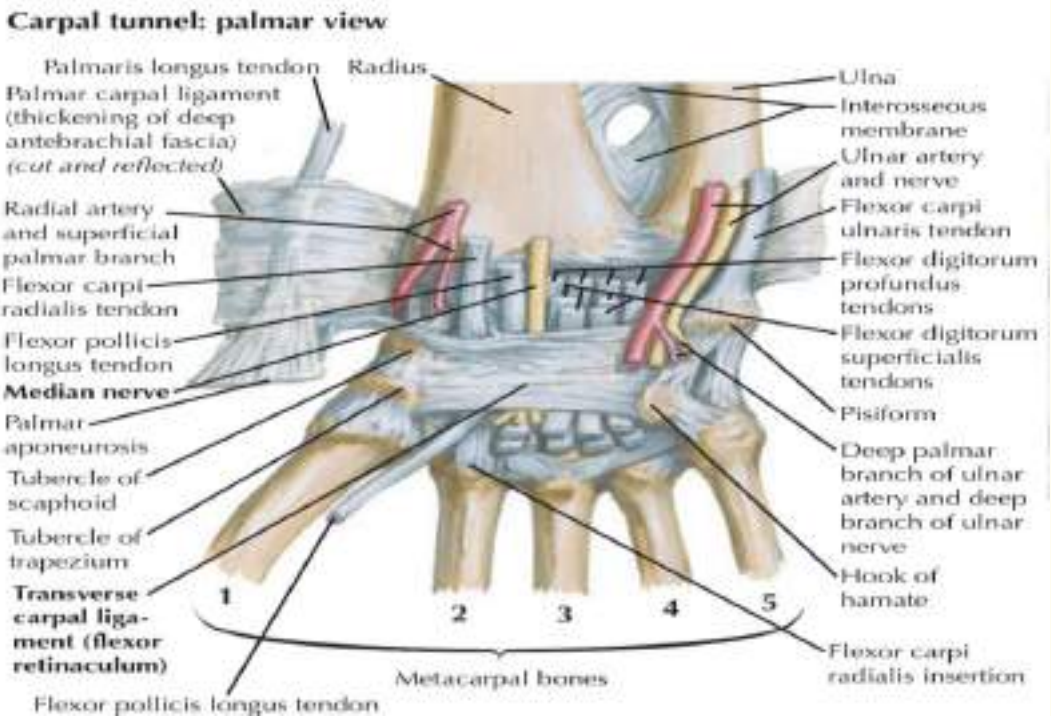
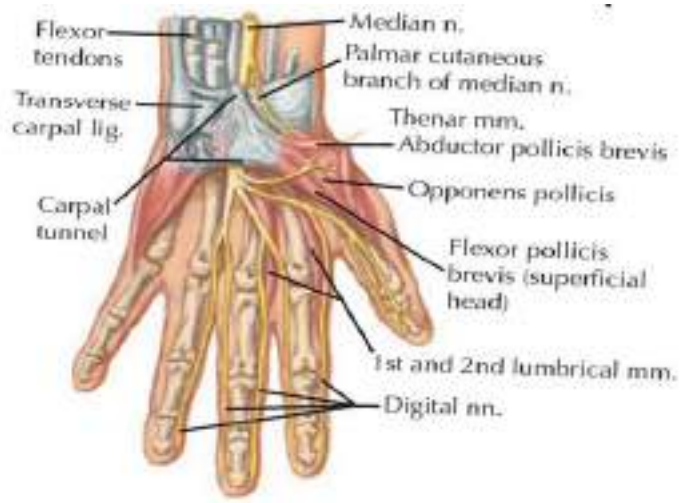
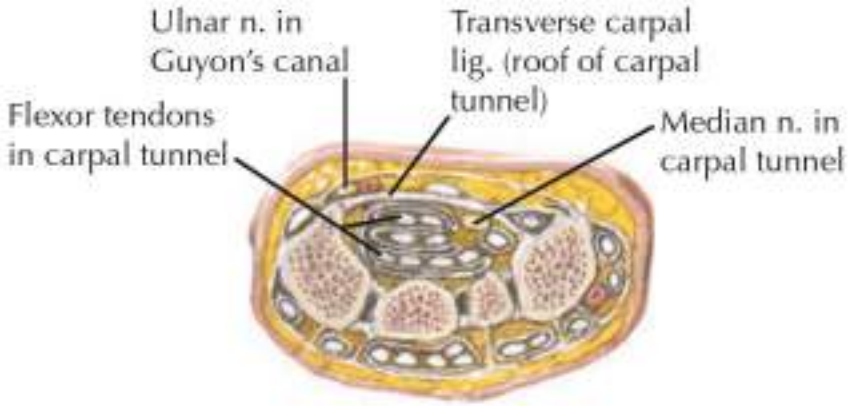
Pic 1: it showed a longitudinal incision that varies from 1.5 – 2 cm placed in the radial border of the ring finger line which is beginning about 2 cm to the distal flexure wrist crease (flexor carpi radialis, flexor carpi ulnaris, kaplan cardinal line, radial side ring finger line)



Pic 2: anatomy of carpal tunnel



Pic 3: anatomy of wrist and hand showing carpal tunnel .


Ulnar n. in Guyon's canal
Transverse carpal lig. (roof of carpal tunnel)
Flexor tendons in carpal tunnel
Median n. in carpal tunnel

Pic 4: saggital view showing median nerve in carpal tunnel.

Pic 5: phalen test- wrist flexion test. Patient experiences numbness and pain on wrist flexion. Highly suggestive of carpal tunnel syndrome.

Pic 6: tinel sign is performed by applying repeated digital percussion over the median nerve in a proximal distal direction.

Pic 7: abductor pollicis brevis is tested by asking the patient to place his thumb perpendicular to the palm and to resist the pressure applied by examiner.

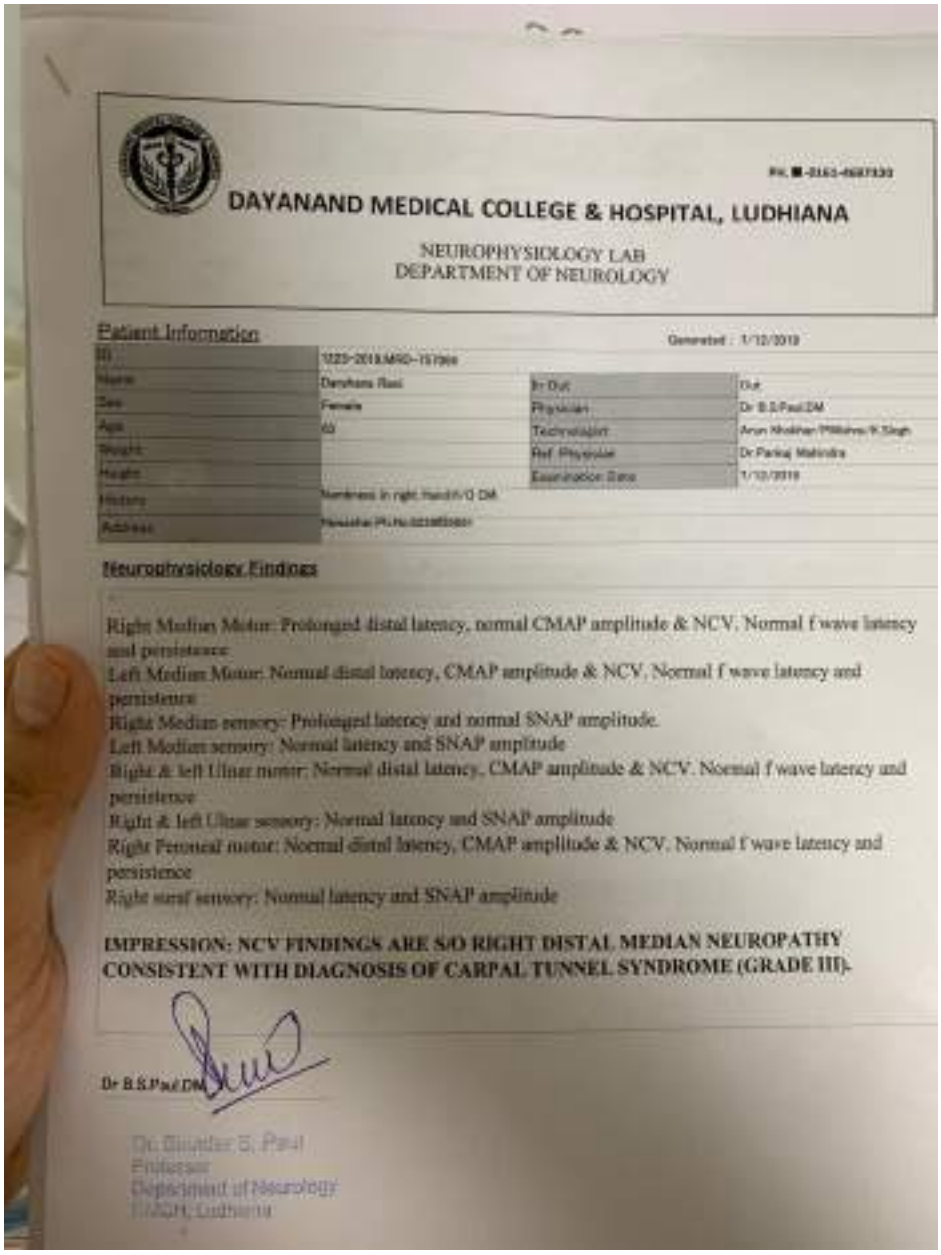
Pic 8: position of position – arm kept on table. Tourniquet given firmly at proximal arm.

Pic 9: patient arm painted with betadine under all aspetic protocol. Sterile green sheets given over patient. Screen attached. Trolley set with ortho fine and minor set with all the instruments.

Pic 10: torniquet pressure set at 249 mm hg. Torniquet deflated after surgery. Approx 13 mins. Then suturing done.

Pic 11: ortho fine set – with all the list - catspaw retractor , spatula

Pic 12: local anaestheis being given after paint and drape of patient with sterile sheets



DAYANAND MEDICAL COLLEGE & HOSPITAL, LUDHIANA

NEUROPHYSIOLOGY LAB
DEPARTMENT OF NEUROLOGY

Patient Information

Generated : 1/12/2019

ID	1220-2019-MRD-15799		
Name	Darshana Rani	In Out	Out
Sex	Female	Physician	Dr B.S.Paul,DM
Age	60	Technologist	Arun Khokhar,Pitambar,R.Singh
Weight		Ref. Physician	Dr Parag Mahindra
Height		Examination Date	1/12/2019
History	Numbness in right hand>O DM		
Address	Rawalsar,Ph.No.9218650660		

Neurophysiology Findings

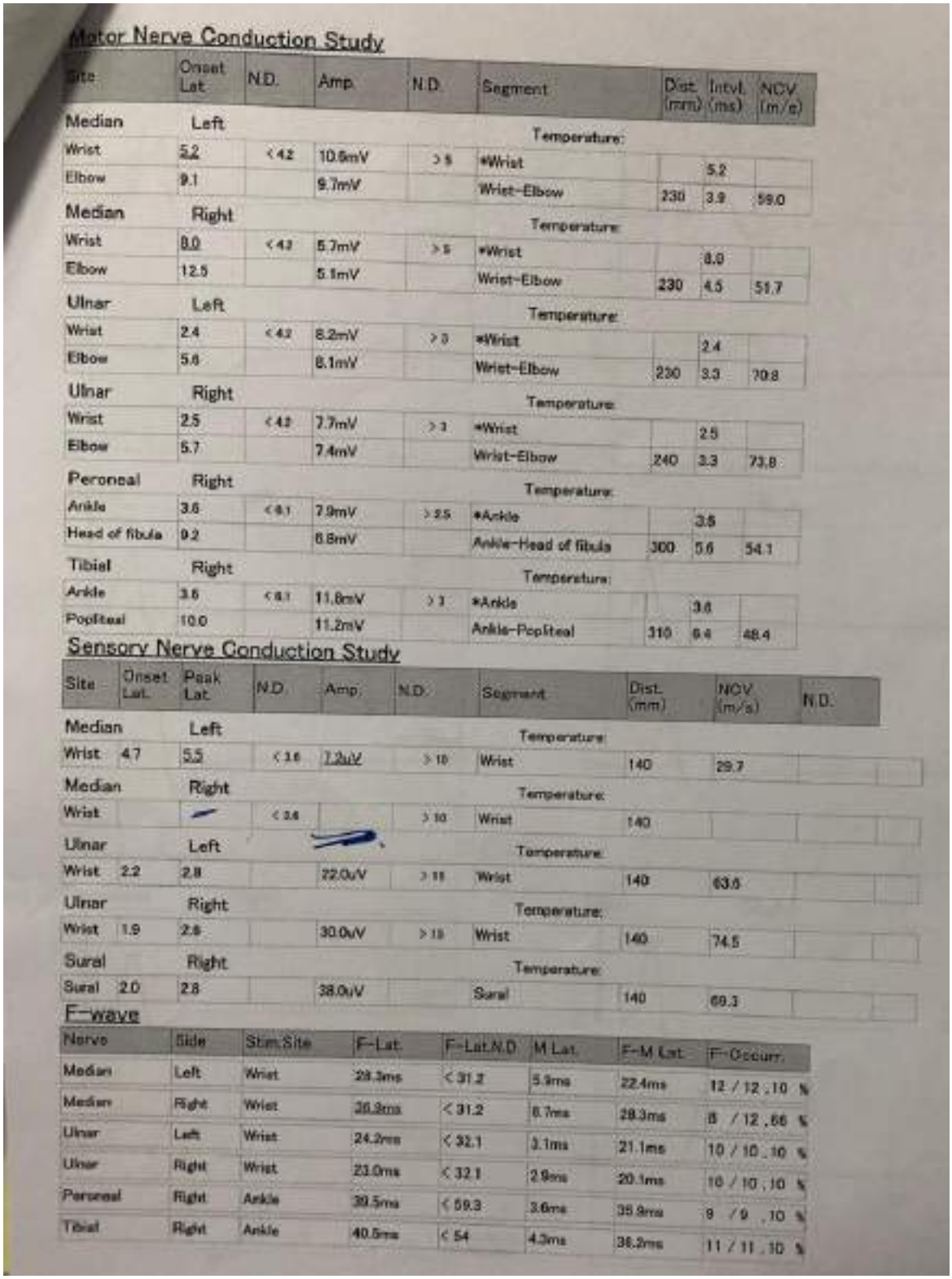
Right Median Motor: Prolonged distal latency, normal CMAP amplitude & NCV. Normal f wave latency and persistence
Left Median Motor: Normal distal latency, CMAP amplitude & NCV. Normal f wave latency and persistence
Right Median sensory: Prolonged latency and normal SNAP amplitude.
Left Median sensory: Normal latency and SNAP amplitude
Right & left Ulnar motor: Normal distal latency, CMAP amplitude & NCV. Normal f wave latency and persistence
Right & left Ulnar sensory: Normal latency and SNAP amplitude
Right Peroneal motor: Normal distal latency, CMAP amplitude & NCV. Normal f wave latency and persistence
Right sural sensory: Normal latency and SNAP amplitude

IMPRESSION: NCV FINDINGS ARE S/O RIGHT DISTAL MEDIAN NEUROPATHY CONSISTENT WITH DIAGNOSIS OF CARPAL TUNNEL SYNDROME (GRADE III).

Dr B.S.Paul,DM

Dr. Bhupinder S. Paul
Professor
Department of Neurology
DMCH, Ludhiana

Pic 13: ncv study of patient- showing right distal median neuropathy consistent with carpal tunnel syndrome(grade iii)



Motor Nerve Conduction Study

Site	Onset Lat.	N.D.	Amp.	N.D.	Segment	Dist. (mm)	Intvl. (ms)	NCV (m/s)
Median	Left				Temperature:			
Wrist	5.2	< 4.2	10.6mV	> 5	*Wrist		5.2	
Elbow	9.1		9.7mV		Wrist-Elbow	230	3.9	59.0
Median	Right				Temperature:			
Wrist	8.0	< 4.2	5.7mV	> 5	*Wrist		8.0	
Elbow	12.5		5.1mV		Wrist-Elbow	230	4.5	51.7
Ulnar	Left				Temperature:			
Wrist	2.4	< 4.2	8.2mV	> 3	*Wrist		2.4	
Elbow	5.6		8.1mV		Wrist-Elbow	230	3.3	70.8
Ulnar	Right				Temperature:			
Wrist	2.5	< 4.2	7.7mV	> 3	*Wrist		2.5	
Elbow	5.7		7.4mV		Wrist-Elbow	240	3.3	73.8
Peroneal	Right				Temperature:			
Ankle	3.6	< 6.1	7.9mV	> 2.5	*Ankle		3.6	
Head of fibula	9.2		6.8mV		Ankle-Head of fibula	300	5.6	54.1
Tibial	Right				Temperature:			
Ankle	3.6	< 6.1	11.8mV	> 3	*Ankle		3.6	
Popliteal	10.0		11.2mV		Ankle-Popliteal	310	6.4	48.4

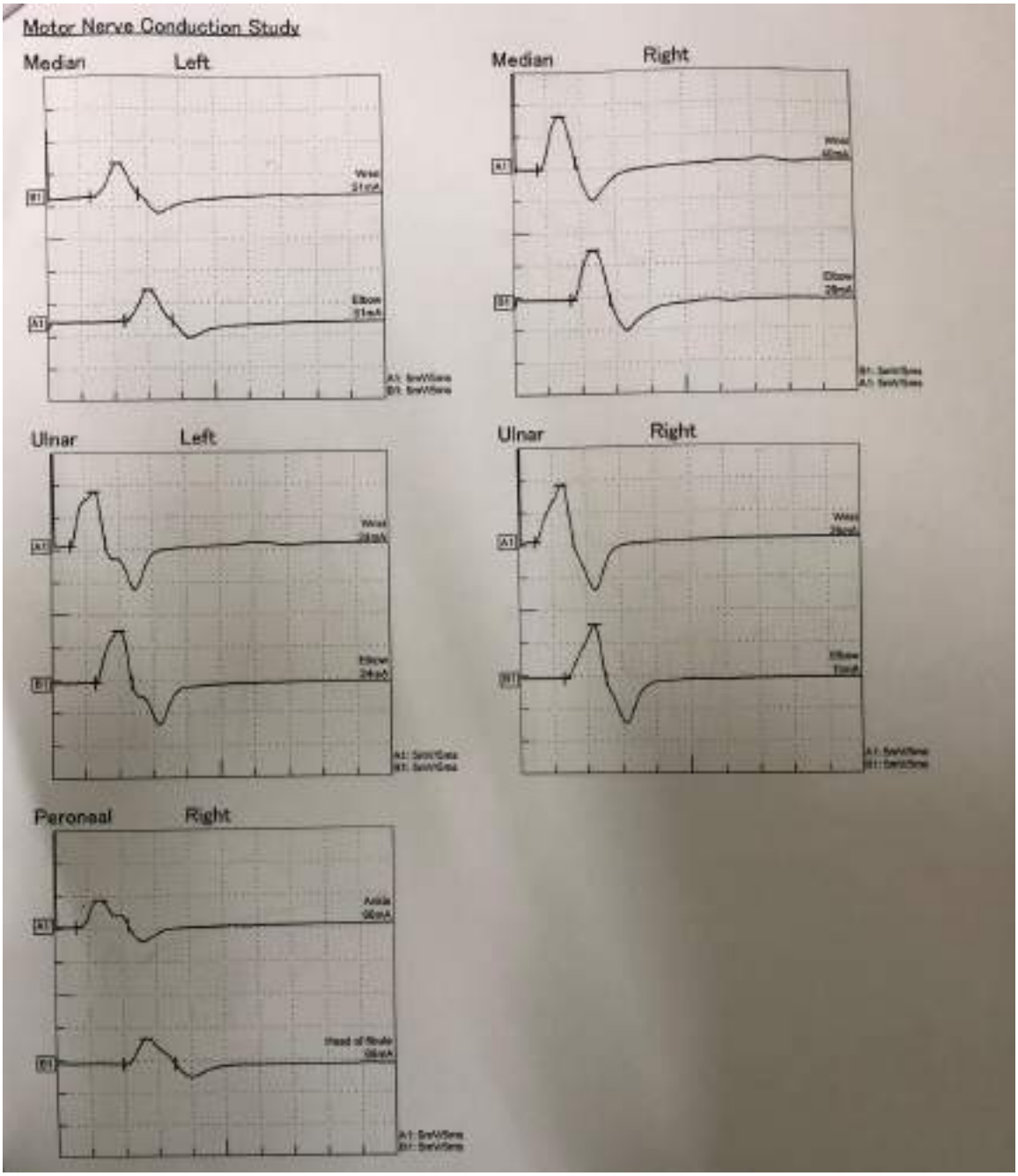
Sensory Nerve Conduction Study

Site	Onset Lat.	Peak Lat.	N.D.	Amp.	N.D.	Segment	Dist. (mm)	NCV (m/s)	N.D.
Median		Left				Temperature:			
Wrist	4.7	5.5	< 3.6	7.2uV	> 10	Wrist	140	29.7	
Median		Right				Temperature:			
Wrist			< 3.6		> 10	Wrist	140		
Ulnar		Left				Temperature:			
Wrist	2.2	2.8		22.0uV	> 10	Wrist	140	63.6	
Ulnar		Right				Temperature:			
Wrist	1.9	2.6		30.0uV	> 10	Wrist	140	74.5	
Sural		Right				Temperature:			
Sural	2.0	2.8		38.0uV		Sural	140	69.3	

F-wave

Nerve	Side	Stim.Site	F-Lat.	F-Lat.N.D.	M Lat.	F-M Lat.	F-Occurr.
Median	Left	Wrist	28.3ms	< 31.2	5.9ms	22.4ms	12 / 12 , 10 %
Median	Right	Wrist	36.9ms	< 31.2	8.7ms	28.3ms	8 / 12 , 66 %
Ulnar	Left	Wrist	24.2ms	< 32.1	3.1ms	21.1ms	10 / 10 , 10 %
Ulnar	Right	Wrist	23.0ms	< 32.1	2.9ms	20.1ms	10 / 10 , 10 %
Peroneal	Right	Ankle	39.5ms	< 59.3	3.6ms	35.9ms	9 / 9 , 10 %
Tibial	Right	Ankle	40.5ms	< 54	4.3ms	36.2ms	11 / 11 , 10 %

Pic 14: ncv study of bilateral upper limb- showing motor and sensory nerve condcution study



Pic 15: ncv study - motor nerve conduction study of median, ulnar and peroneal nerve.

Pic 16 a: ortho fine set

Pic 16 b: knifes, scissor, sponge, forceps, retractor, catspaw retractor

Pic 17: before surgery, the affected hand, wrist, and forearm were cleaned with povidone-iodine solution. The area to be operated was covered with a sterile compress. Pneumatic tourniquet was used. An ideal hand position is obtained with a wrist extension of 30 degrees, the handheld in place by a cushion placed under the wrist joint and with the thumb abducted.

Pic 18: (flexor carpi radialis, flexor carpi ulnaris, kaplan cardinal line, radial side ring finger line)

Pic 19: the incised skin was retracted with the help of a catspaw retractor and subcutaneous fat tissue was dissected laterally

Pic 20: spatula used for flexor retinaculum dissection.

Pic 21: longitudinal mini incision release- carpal tunnel and ligament exposed.median

Pic 22: nerve decompression done median nerve distribution

Pic 23: palmar ligament cut with knife. 11 no. Blade

Pic 24: spatula

Pic 25: scissor for distal and proximal

Pic 26: only 1.5 mm small incision

Pic 27: long scissor distal dissection

Pic 28: vicryl (3-0) , monocryl (4-0) for wound closure

Pic 29: subcuticular monocryl (4-0)

Pic 30: steri strips applied after wound closure with subcuticular sutures

Pic 31: patient given compression bandage with limb elevated. And kept in ortho recovery for post op observation.

Pic 32: day -1 post op dressing seen. Mild sokage was ther with mild skin maceration. So dry dressing was done and wound healed.

Pic 33: right cts at 3 month follow up in opd. Wound healed fully. No cosmetic deformity. No scar tenderness was there. Patient was fulled relieved from numbness and pain.

Pic 34: close view of 1 month follow up in opd patient was relieved from pain, numbness. With no symptoms now.

Pic 35: patient in opd at 2 month follow up. Symptoms relieved.

Pic 36: at 3 month follow up in opd all symptoms relieved.

Patient at 6 month follow up . scar mark fully healed. No pain , no sensitivity .

DURATION OF SYMPTOMS	DATE OF ADMISSION	DATE OF DISCHARGE	DATE OF OPERATION/PROCEDURE	OPERATION/PROCEDURE	ANAESTHESIA USED	COMORBIDITIES	COMPLICATIONS	BOSTON TUNNEL CARPEL QUESTIONNARIE(FUNCTIONAL STATUS SCORE)											
								PRE- F1	POST- F1	PRE- F2	POST F2	PRE F3	POST F3	PRE F4	POST F4	PRE F5	POST F5	PRE F6	POST F6
1 YEAR	03/06/19	04/06/19	03/06/19	CTS RELEASE RIGHT SIDE	LOCAL	NO COMORBIDITY	NO	4	1	4	1	4	1	4	1	4	2	5	2
2Years	20/04/19	20/4/19	20/4/19	CTS RELEASE LEFT SIDE	LOCAL	NO COMORBIDITY	No	4	1	3	1	3	1	4	1	5	1	5	2
8years	10/06/19	10/06/19	10/06/19	CTS RELEASE RIGHT SIDE	LOCAL	Migraine	NO	3	1	3	1	4	2	4	1	4	1	4	1
1year	10/06/19	10/06/19	10/06/19	CTS RELEASE RIGHT SIDE	LOCAL	Hypothyroid	NO	3	1	3	1	3	1	2	1	3	1	4	1
2Years	25/05/19	25/05/19	25/05/19	CTS RELEASE LEFT SIDE	LOCAL	Htn	NO	4	2	4	2	4	1	5	2	4	2	5	1
2years	05/02/19	05/02/19	05/02/19	CTS RELEASE LEFT SIDE	Supraclavicular block	HTN, DM, HYPOTHYROID	NO	4	1	5	1	4	1	4	1	5	1	4	1
4 MONTHS	28/06/19	28/06/19	28/6/19	BILATERAL CTS RELEASE	LOCAL	DM , HTN , RA	No	4	2	4	2	4	2	3	2	5	4	4	4
1 YEAR	05/02/19	05/02/19	05/02/19	CTS RELEASE RIGHT SIDE	LOCAL	NO COMORBIDITY	NO	3	1	3	1	4	1	3	1	4	1	4	1
3YEARS	28/12/18	28/12/18	28/12/18	CTS RELEASE LEFT SIDE	BLOCK	DM ,HTN	NO	4	2	4	2	4	2	3	2	4	2	5	2
2YEARS	25/03/19	25/03/19	25/3/19	CTS RELEASE RIGHT SIDE	LOCAL	HTN, MIGRAINE	No	4	1	4	1	3	1	4	1	5	1	5	1
1year	21/02/19	21/02/19	21/2/19	CTS RELEASE RIGHT SIDE	LOCAL	NO COMORBIDITY	NO	3	1	4	1	4	1	3	1	4	1	4	1
6months	18/02/19	18/02/19	18/2/19	CTS RELEASE LEFT SIDE	Supraclavicular block	HTN	NO	4	1	3	1	4	1	4	1	5	2	4	1
6months	04/07/18	06/07/18	05/07/18	CTS RELEASE RIGHT SIDE	LOCAL	HTN, DM	NO	4	2	3	2	4	2	4	2	4	2	3	1
1year	13/7/19	13/7/19	13/7/19	CTS RELEASE RIGHT SIDE	LOCAL	DM, HTN	NO	4	1	3	1	4	1	3	1	4	1	3	1
6months	28/06/19	28/06/19	28/06/19	RIGHT RELEASE. P/O LEFT SIDE	LOCAL	NO COMORBIDITY	No	4	1	3	1	3	1	4	1	5	2	4	1
2 YRS	03/02/18	03/02/18	03/02/18	CTS RLEASE LEFT SIDE	LOCAL	HTN , DM	NO	3	1	2	1	3	1	3	1	5	1	3	1
1year	13/7/19	13/7/19	13/7/19	CTS RELEASE LEFT SIDE	LOCAL	DM	NO	4	1	3	1	4	1	4	1	4	1	3	1
1 YEAR	03/04/18	03/04/18	03/04/18	CTS RELEASE RIGHT SIDE	LOCAL	NO COMORBIDITY	NO	4	1	3	1	3	1	4	1	4	1	4	1
1year	07/04/18	07/04/18	07/04/18	CTS RELEASE LEFT SIDE	LOCAL	Hypothyroid , OA knee(B/L tkr)	NO	3	1	4	1	4	1	3	1	4	1	3	1
1.5 YEAR	09/01/18	09/01/18	09/01/18	CTS RELEASE RIGHT SIDE	LOCAL	HTN , DM	NO	4	1	4	1	4	1	4	1	5	2	4	1
1.5year	02/01/18	02/01/18	02/01/18	CTS RLEASE RIGHT SIDE	LOCAL	OBESE 124KG, HTN	NO	3	1	4	1	3	1	4	1	5	2	2	1
6months	04/06/18	04/06/18	04/06/18	CTS RELEASE RIGHT SIDE	LOCAL	CERVICAL RADICULOPATHY	NO	3	1	4	1	4	1	3	1	4	1	4	1
10YEARS	12/07/18	13/07/18	13/7/18	CTS RELEASE LEFT SIDE	SHORT GA	HYPOTHYROID	NO	2	1	2	1	3	1	3	1	4	1	3	2
1 YEAR	07/03/19	07/03/19	07/03/19	RIGHT	LOCAL	Diabetes mellitus	No	4	2	4	2	4	2	4	2	5	3	5	3
1.5YEAR	27/04/19	27/04/19	27/4/19	CTS RELEASE RIGHT SIDE	LOCAL	NO COMORBIDITY	NO	4	2	3	1	4	2	3	1	4	3	4	2
1 YEAR	23/11/18	23/11/18	23/11/2018	CTS RELEASE LEFT SIDE	LOCAL	NO COMORBIDITY	NO	4	2	3	2	4	1	4	1	5	2	4	2
10YEARS	21/06/18	21/06/18	21/6/2018	CTS RELEASE RIGHT SIDE	SHORT GA + LMA	DM	NO	3	1	4	2	3	2	4	2	4	3	4	3
5MONTHS	22/02/2019	22/02/2019	22/02/2019	BILATERAL CTS RELEASE	SHORT GA	HTN, CAD, OSTEOPOROSIS	NO	4	2	3	2	4	2	4	2	4	3	3	2
1 YEAR	09/01/19	09/01/19	09/01/19	CTS RELEASE LEFT FIRST	LOCAL	DM , HTN	NO	4	1	3	1	4	1	4	1	4	1	4	1
2 YEAR	26/12/2018	26/12/2018	26/12/2018	CTS RELEASE B/L	LOCAL	NO COMORBIDITY	-	3	2	4	2	4	2	3	1	4	2	3	1
1YEAR	24/12/18	24/12/18	24/12/2018	CTS RELEASE RIGHT SIDE	BLOCK	HYPOTHYROID	NO	4	2	4	2	4	2	4	2	4	3	3	2
2YEARS	16/8/18	16/8/18	16/8/18	CTS RELEASE LEFT SIDE	LOCAL	HTN , DM	NO	3	1	3	1	4	1	3	1	4	1	3	1
6 MONTHS	13/8/2018	13/08/18	13/8/18	CTS RELEASE LEFT SIDE	LOCAL	DM, HYPOTHROID	NO	3	1	4	1	4	1	3	1	4	1	4	1
1 YEAR	16/09/17	16/09/17	17/09/17	CTS RELEASE RIGHT SIDE	LOCAL	NO COMORBIDITY	NO	3	1	3	1	4	1	2	1	4	1	3	1
2 YEARS	21/05/18	21/05/18	21/05/18	LEFT	LOCAL	DM	NO	3	1	2	1	3	1	3	1	4	1	3	1
3 MONTHS	29/08/18	29/08/18	29/08/18	RIGHT	LOCAL	NO	NO	4	1	3	1	3	1	3	1	3	1	2	1
2MONTHS	01/11/18	01/11/18	01/11/18	LEFT	BLOCK	NO	NO	4	2	3	2	3	2	4	3	4	2	4	3
2 YEARS	09/10/18	09/10/18	09/10/18	B/ L	SHORT GA	HTN	NO	3	1	4	2	3	2	4	2	4	3	3	2
1YEAR	11/10/18	11/10/18	11/10/18	RIGHT	LOCAL	HTN , HYPOTHYROID	NO	4	1	3	1	4	1	3	1	4	1	3	1
2YEARS	11/09/18	11/09/18	11/09/18	RIGHT	LOCAL	CERICAL SPONDYLOSIS	no	3	1	4	1	3	1	3	1	3	1	4	1
4MONTHS	01/11/18	01/11/18	01/11/18	RIGHT	LOCAL	NO COMORBIDITY	N0	3	1	3	1	4	1	3	1	4	1	3	1

				-
PRE F7	**POST F7**	**PRE F8**	**POST F8**	**SUBJECTIVE RESULT**
5	2	4	1	EXCELLENT
5	2	4	2	EXCELLENT
4	1	3	1	EXCELLENT
3	1	3	1	EXCELLENT
4	1	4	1	GOOD
4	1	3	1	EXCELLENT
4	3	4	3	GOOD
4	1	4	1	EXCELLENT
4	2	4	2	GOOD
4	1	3	1	EXCELLENT
5	1	4	1	EXCELLENT
5	1	5	1	EXCELLENT
4	2	4	2	GOOD
4	1	4	1	EXCELLENT
4	1	3	1	EXCELLENT
4	1	3	1	EXCELLENT
4	1	3	1	EXCELLENT
4	1	3	1	EXCELLENT
4	1	3	1	EXCELLENT
3	1	4	1	EXCELLENT
4	1	3	1	GOOD
4	1	3	1	GOOD
3	1	3	1	GOOD
4	3	4	3	FAIR
4	1	4	1	GOOD
3	1	3	1	FAIR
4	3	3	3	POOR
3	3	4	3	POOR
4	1	4	1	EXCELLENT
4	2	3	2	PAIR
3	2	3	2	POOR
3	1	4	1	EXCELLENT
4	1	3	1	EXCELLENT
3	1	3	1	EXCELLENT
4	1	4	1	EXCELLENT
3	1	2	1	GOOD
3	3	3	2	FAIR
3	2	3	2	FAIR
4	1	4	1	GOOD
3	1	3	1	EXCELLENT
3	1	3	1	EXCELLENT

Baba Farid University
of Health Sciences
Sadiq Road
Faridkot-151 203 (Pb). INDIA.
Phone : 01639-256232,256236
Tele/Fax : 01639-256235
Email – Examination@bfuhs.ac.in

No. BFUHS/2K18p-TH/ 14156

Date 4/10/18

The Principal,
DMC, Ludhiana.

Subject: **Approval of Plan of Thesis.**

This is to inform you that the Faculty of Medical Sciences in its meeting held on 31.08.2018 has approved the plan of thesis of Dr. Ashish Monga, a student of your college for **MS Orthopaedics** along with the names of Supervisor/Co-Supervisor as under:-

Topic Plan of Thesis
Outcome and evaluation of mini incision release for carpal tunnel syndrome

Supervisor
Dr. Pankaj Mahindra
Assoc. Prof.,
Dept. of Orthopaedics,
DMCH, Ludhiana.

Co-Supervisor
Dr. Rajnish Garg
Prof. & Head,
Dept. of Orthopaedics,
DMCH, Ludhiana.

Dr. Rajinder Bansal
Prof.,
Dept. of Neurology,
DMCH, Ludhiana..

The student may submit the four copies of thesis, to the Controller of Examinations, BFUHS, Faridkot, at least six months before the commencement of theory examination, if he/she is otherwise eligible to take the examination. He /She may be directed to attach a photocopy of this letter with the forwarding letter while submitting thesis in the University along with the letter of approval of University for change of supervisor/Co-Supervisor, change of topic, if any.

Dr. S P Singh MS(Oph)
Controller of Examinations

Note :

1. *If any discrepancy found regarding topic of thesis or Supervisor/Co-Supervisor, inform undersigned within one month after issue of this letter.*
2. *The student may submit the thesis as per the schedule already conveyed i.e for May/June examination 30th Nov of the preceding the year of examination and for Nov/Dec examinations 31st May of the year of examination.*

OUTCOME AND EVALUATION OF MINI INCISION RELEASE FOR CARPAL TUNNEL SYNDROME

THESIS PROPOSAL

FOR APPROVAL OF SUBJECT OF THESIS TO BE SUBMITTED

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

MASTER OF SURGERY

IN

ORTHOPAEDICS

OF THE

BABA FARID UNIVERSITY OF HEALTH SCIENCES

FARIDKOT

January, 2018

DR. ASHISH MONGA

DEPARTMENT OF ORTHOPAEDICS

DAYANAND MEDICAL COLLEGE AND HOSPITAL, LUDHIANA

ABSTRACT OF PLAN OF THESIS

Title	OUTCOME AND EVALUATION OF MINI INCISION RELEASE FOR CARPAL TUNNEL SYNDROME
For the degree of	MS ORTHOPAEDICS
Name of the candidate	Dr. ASHISH MONGA
Supervisor	Dr. PANKAJ MAHINDRA
Co-supervisors	Dr. RAJNISH GARG DR RAJINDER BANSAL
Institution	Dayanand Medical College & Hospital, Ludhiana
University	Baba Farid University of Health Sciences, Faridkot

Introduction: Mini- incision techniques for carpal tunnel release have become increasingly popular for the treatment of carpal tunnel syndrome. The main advantages of mini incision techniques are shorter recovery and return-to-work time. However, the risk of neurovascular injury still remains worrisome. This novel technique combines the advantages of endoscopic and open techniques while utilizing standard instruments .

Aim of study: The purpose of this study is to evaluate outcome of surgically treated carpal tunnel syndrome in presence of multidisciplinary management facilities in present day scenario.

Material & methods : Study would be based on a prospective review of the medical records of cases of carpal tunnel syndrome who will undergo mini-incision release between January 2018 and Nov 2019 at Dayanand Medical college & Hospital, Ludhiana. Patients will be followed up by clinical examinations and final assessment of functional outcome will be made.

Clinical Significance: The study will show the outcome of mini-incision release for carpal tunnel syndrome. Various complications and their incidence would also be assessed. The study will act as a benchmark to set up guidelines for management of Carpal tunnel syndrome.

Keywords: Carpal Tunnel Syndrome, Mini Incision Release, Nerve Conduction velocity

Ashish Monga

(Signature) Candidate	(Signature) Co-supervisor	(Signature) Co-supervisor	(Signature) Supervisor	(Signature) Principal

CERTIFICATE OF FACILITIES AVAILABLE

This is to certify that the facilities for work on the subject of thesis titled **"OUTCOME AND EVALUATION OF MINI INCISION RELEASE FOR CARPAL TUNNEL SYNDROME"** exist in the Department of Orthopedics, DMC&H, Ludhiana, and will be provided to the candidate. We will see that the data being included in the thesis are genuine and is collected by the candidate himself under our supervision and guidance.

SUPERVISOR:

DR. PANKAJ MAHINDRA
Associate Professor
Department of Orthopaedics
DMC&H, Ludhiana

CO-SUPERVISOR:

DR. RAJNISH GARG
Professor & Head
Department of Orthopaedics
DMC&H, Ludhiana

DR. RAJINDER BANSAL
Professor
Department of Neurology
DMC&H, Ludhiana

Place: Ludhiana

Date: 17/01/2018

APPROVAL PROFORMA
BY RESEARCH & ETHICAL COMMITTEE
DAYANAND MEDICAL COLLEGE & HOSPITAL, LUDHIANA

Name of candidate	DR. ASHISH MONGA
Department	ORTHOPAEDICS
Topic of Thesis	OUTCOME AND EVALUATION OF MINI INCISION RELEASE FOR CARPAL TUNNEL SYNDROME
Likely date of appearing in PG examination	JUNE 2020
Date of enrollment	31st May, 2017
Name of Head of Department	DR. RAJNISH GARG
1. Supervisor 2. Co-Supervisor	DR. PANKAJ MAHINDRA DR. RAJNISH GARG DR. RAJINDER BANSAL
Signature of Members of Research Committee with Stamp	**Signature of Members of Ethics Committee with Stamp**
1. HOD Pharmacology	1. HOD Physiology
2. HOD Surgery	2. HOD Pathology
3. HOD Pathology	3. HOD Pharmacology
4. HOD Medicine	4. HOD SPM
5. Dean Academics	5. HOD Medicine
6. Vice Principal	7. HOD Surgery
	7. HOD Obst. & Gynae.
	8. Legal Expert
	9. Secretary, IEC
	10. Dean Academics
	11. Vice Principal
	12. Principal

Approved: Yes / No

Chairperson
Research Committee

Approved: Yes / No

Chairperson
Ethics Committee

Chairperson
Research Committee

Chairperson
Ethics Committee

BABA FARID UNIVERSITY OF HEALTH SCIENCES, FARIDKOT

PROFORMA FOR REGISTRATION OF SUBJECT FOR DISSERTATION

1	NAME OF THE CANDIDATE AND ADDRESS	DR. ASHISH MONGA DASHMESH NAGAR, MANDI KILLIANWALI, DISTRICT- SRI MUKTSAR SAHIB, PIN 151211, PUNJAB
2	NAME OF THE INSTITUTE	DAYANAND MEDICAL COLLEGE AND HOSPITAL,LUDHIANA
3	COURSE OF STUDY AND SUBJECT	MASTER OF SURGERY, ORTHOPAEDICS
4	DATE OF ADMISSION OF COURSE	31 MAY, 2017
5	TITLE OF THE TOPIC	OUTCOME AND EVALUATION OF MINI INCISION RELEASE FOR CARPAL TUNNEL SYNDROME

6. BRIEF RESUME OF THE INTENDED WORK

6.1 NEED FOR THE STUDY

Carpal tunnel syndrome (CTS) is the most common peripheral entrapment neuropathy.[1] The pathophysiology involves a combination of mechanical trauma, increased pressure, and ischemic injury to the median nerve within the carpal tunnel. [2] The standard means for diagnosing CTS is NCS along with the classical presenting symptoms. Management strategy is a spectrum between conservative treatment with physiotherapy, steroids, and surgery.

Since the surgical treatment was introduced, carpal tunnel release has been extensively reviewed and many modifications have been suggested with different instruments and incision techniques. Traditional open release has been the standard approach worldwide since Phalen promoted it in 1950.[3]

The surgeries described in literature for CTS can be classified into endoscopic and nonendoscopic methods of carpal tunnel release. Nonendoscopic release procedures comprise traditional release, limited incision release, and mini-incision release.[4]

Effectiveness and safety of these various methods still remain controversial. The traditional open release has a few associated incidence of hypertrophic scarring, scar tenderness, pillar pain, and delayed return to work.[5-9]

Limited incision method, mini-incision methods, and endoscopic methods all are proposed to be effective for preventing the excessive scar formation, reducing pillar pain, and the early return to work.[10-12] The limited release techniques claim to have most of the advantages of endoscopic release with almost similar end results and lesser learning curve.[13]

For diagnosing multiple compression neuropathies, motor conduction velocity and distal motor latency (DML) in the median and ulnar nerves in the same hand was done.[14,15]

The gold standard treatment for CTS in cases of severe CTS and failed conservative management cases has been surgical release.[16,17]

The advantages cited with endoscopic release over open method are decreased postoperative morbidity, early return to work, aesthetic scar. Still there are complications documented such as laceration of the superficial palmar arc, median nerve transection, injuries of digital nerves, vessels, and insufficient release of the carpal tunnel.[18]

The metaanalysis by Thomas *et al.* which compared two techniques of open and endoscopic surgery showed that endoscopic technique had less pain in the incision site and better improvement in grasping objects at 12 weeks, but there was three times greater likelihood of nerve damage than the open surgery group.[19] There are also concerns regarding duration of surgery, cost of surgery, equipment cost, and surgical training required.

The purpose of this prospective study was to look into technique of mini-incision carpal tunnel release to evaluate its effectiveness clinically and neurologically.

6.2 REVIEW OF LITERATURE

Heidarian et al in 2013 published study on"Comparison of Knifelight Surgery versus Conventional Open Surgery in the Treatment of Carpal Tunnel Syndrome". To compare the Knifelight instrument and open carpal tunnel release with respect to scar length, operation duration, recovery time needed before return to work and amount of pain three weeks after surgery in patients with neurophysiologically confirmed carpal tunnel syndrome. FIFTY NINE PATIENTS WITH INDICATION FOR CARPAL TUNNEL RELEASE RANDOMLY ASSIGNED INTO TWO GROUPS: open (n=30) or Knifelight (n=29). The patients compared regarding scar length, operation duration, time to return to daily activities and amount of pain at three weeks after operation based on Visual Analog Scale. There was no significant differences regarding age and sex in the two groups. The scar length, operation duration and time before return to daily activities were significantly lower in the Knifelight group. Although the mean visual analogue scale of Knifelight group found to be lower than the other, it was not statistically significant. The Knifelight technique is accompanied with advantages over the open surgery regarding operation time, scar length and time to return to daily activities. The pain relieve based on Visual Analog Scale was not statistically different from conventional open surgery.[20]

Kim et al in 2013 published study on "Pressure-morphology relationship of a released carpal tunnel". In which Carpal tunnel release (CTR) was performed endoscopically on cadaveric hands and the carpal tunnel pressure was dynamically increased from 10 to 120 mmHg. Simultaneously, carpal tunnel cross-sectional images were captured by an ultrasound system, and pressure

measurements were recorded by a pressure transducer. Carpal tunnel pressure significantly affected carpal arch area ($p < 0.001$), with an increase of >62 mm(2) at 120 mmHg. Carpal arch height, length, and width also significantly changed with carpal tunnel pressure ($p < 0.05$). As carpal tunnel pressure increased, carpal arch height and length increased, but the carpal arch width decreased. Analyses of the pressure-morphology relationship for a released carpal tunnel revealed a nine times greater compliance than that previously reported for a carpal tunnel with an intact TCL. This change of structural properties as a result of transecting the TCL helps explain the reduction of carpal tunnel pressure and relief of symptoms for patients after CTR surgery.[21]

Sanati et al in 2012 published study on "Surgical techniques and return to work following carpal tunnel release: a systematic review and meta-analysis".This systematic review was conducted to evaluate return to work (RTW) following minimally invasive carpal tunnel surgery versus open carpal tunnel release. This study also assesses how RTW as an outcome measure was examined in previous randomized controlled trials (RCTs). The bibliographic databases Medline, AMED and CINAHL were systematically searched. We found 15 relevant RCTs. Meta-analysis was possible only for four studies. The result indicates that minimally invasive surgery offers earlier return to work compared to open carpal tunnel release (mean difference -7.2 days; 95% CI -10 to -4.4 days).[22]

Wongsiri et al in 2008 published study on "A new tool for mini-open carpal tunnel release the PSU retractor". Mini-open carpal tunnel release has become increasingly popular for the treatment of carpal tunnel surgery. The

main advantages are shortening recovery time and return-to-work time. However, the risk of neurovascular injury still remains worrisome. In this study, we developed a new retractor (herein called the PSU retractor) modified from the widely used Senn retractor, with the aim of decreasing the risk of neurovascular problems from normal procedure. 3-Dimensional computer design software (SolidWorksÂ® Office Premium 2007 SP3.1) was used to construct a 3-D PSU retractor prototype. An amputated arm from a 30-year-old woman diagnosed as synovial sarcoma at the shoulder was used to test the maximal visual length. A mini-surgical incision was performed at 3 cm distal to the transverse wrist crease and a tiny flexible ruler was inserted through the tunnel beneath the skin to measure the maximal visual length. Our new retractor showed significantly better maximal visual length compared to the Senn retractor (47.7(8.1) mm vs. 39.2(6.5) mm). In addition, most assessors expressed a higher satisfaction rate with the PSU retractor than with the Senn retractor (7.3 (1.9) vs. 6.3 (1.1)). In conclusion, we have developed a promising new retractor using a computer design program, which appears to be an improvement on the currently available equipment used for mini-open carpal tunnel surgery. However, further clinical studies are needed to confirm our initial findings.[23]

Yeo et al in 2007 published study on "Comparison of the results of open carpal tunnel release and Knife Light carpal tunnel release". The study compares the results of open release of carpal tunnel syndrome with a release done with a proprietary instrument, the Knife Light, which uses a minimal access approach. A retrospective study was conducted on two groups of patients operated on by the same surgeon between January 1998

and August 2002. All cases presented with numbness of six months duration or more, and a positive Phalen's test. Open carpal tunnel release was done in the first group of 26 consecutive patients before the Knife Light was introduced in January 2000. The Knife Light technique was used in a second consecutive group of 49 patients. In two patients, the Knife Light procedure was abandoned because the median nerve could not be safely separated from the transverse carpal ligament. The two groups were shown to be comparable with respect to clinical presentation and nerve conduction studies.[24]

Cellocco et al in 2005 published study on "Mini-open blind procedure versus limited open technique for carpal tunnel release: a 30-month follow-up study".To evaluate prospectively the safety and effectiveness of a mini-open blind technique for carpal tunnel release (group A) when compared with a limited open technique (group B). From November 1999 to May 2001 (mean follow-up period, 30 mo) we performed 222 carpal tunnel release procedures on 185 consecutive patients. All patients were affected by mild to moderate median nerve compression. Patients in group A (82 patients, 99 procedures) had a short transverse incision at the wrist (length, 2 cm). We used a manual surgical instrument that helps in blindly dividing the flexor retinaculum because it has an integrated light source. The light makes it possible to locate precisely the tool blade by transillumination. Patients in group B (103 patients, 123 procedures) had a limited longitudinal incision (length, 3-4 cm). The preoperative and postoperative patient statuses were evaluated with an Italian modified version of the Boston Carpal Tunnel questionnaire with a mean of 30 months' follow-up after surgery (range, 24-39 mo). Group A patients showed

better results than group B patients in all of the sections of the Italian modified version of the Boston Carpal Tunnel questionnaire at a mean follow-up period of 19 months, whereas after a mean of 30 months of follow-up evaluation the differences between groups A and B tended to decrease. Disease recurred in 7 group B patients, whereas only 1 patient in group A experienced symptom recurrence at the latest office evaluation. The blind mini-invasive technique has been shown to be as safe as traditional techniques but the recovery period is significantly shortened. With the technique we described a low recurrence rate was observed. All patients in group A reported great reduction in preoperative pain and numbness.[25]

6.3 AIMS AND OBJECTIVES OF THE STUDY

- To study the outcome of mini-incision release in patients of carpal tunnel syndrome.
- To evaluate the functional outcome of operatively managed patients.
- To access the complications associated with Carpal tunnel syndrome

7. MATERIALS AND METHODS

7.1 SOURCE OF DATA

The purpose of this study is to review and analyse the outcome of procedure. Study would be based on a retrospective and prospective review of the medical records of all cases of CTS who will undergo MINI-INCISION RELEASE between January 2017 and December 2019 at Dayanand Medical college Hospital, Ludhiana. Patients will be followed up monthly by clinical examination and final assessment will be made using 6 months after surgery whichever is later.

7.2 METHOD OF COLLECTION OF DATA

Study would be based on a retrospective and prospective review of the medical records of all cases of CTS who will undergo release between January 2017 and December 2019 at Dayanand Medical college Hospital, Ludhiana.

INCLUSION CRITERIA:-

- Age group 18 to 70 years of either sexes.
- Carpal tunnel syndrome according to classification Confirmed by clinical examination, and if required NCS /EMG.
- Patients who give informed consent and willing for follow up.

EXCLUSION CRITERIA:-

- Patients having CTS with non-operative management
- Patients less than 18 years of age.
- Patients unfit for surgery.
- Pregnancy.
- Associated comorbid conditions -Major psychiatric illness

Pre Operative Regimen

A detailed history will be taken from the patient presenting to the hospital emergency or the department.. He/ She will undergo complete physical examination. All other systems will also be assessed and managed by respective departments. Routine investigations as per protocol. Any coexisting comorbidities such as diabetes mellitus, smoking, steroid use, alcoholism, old age will also be taken into account and recorded. Pre anaesthetic check up and consultation from suitable department will be taken or any coexisting comorbidity. Patients will be taken up for surgery after clearance from the respective department and Anaesthesia team.

Preparation in the OT

Patient will be placed on OT table and positioned in supine position. Patient will be administered suitable anaesthesia (LA/block/GA/Regional) by the anaesthesia team. The cleaning will be done using 10% Povidone Iodine and draped using all sterile precautions.

Operative Procedure:

The mini incision technique will be performed after local anesthesia with an upper- arm pneumatic tourniquet/GA/BLOCK. The 1-cm first incision will be marked in the palm, beginning at the intersection of Kaplan's cardinal line and a line drawn along the radial border of the third web. The 1.5 cm second skin incision will be made on a line between palmaris longus and the flexor carpi ulnaris tendons. After the first skin incision, the subcutaneous tissue will be incised with a no. 15 blade and two retractors will be positioned to separate the edges of the incision. The palmar fascia will be divided by blunt dissections. The distal edge of flexor retinaculum and median nerve will be

visualized. After the second skin incision made at the wrist level, the proximal edge of the flexor retinaculum and median nerve will be identified. A long nasal speculum will then be pushed proximally from the first incision to the second incision and introduced between the palmar fascia and the transverse carpal ligament. Anasal septum knife (Ballenger) will then be gently pushed distally to divide the flexor retinaculum. The flexor retinaculum between the blade and handle will be completely incised under direct vision.

The incisions will be closed with interrupted 4-0 nylon sutures and a pressure bandage will be applied. The tourniquet will be then released. No splint will be used, and the patients will be encouraged to move their hands and fingers in the immediate postoperative period. The original dressing will be removed after 5 days, and the stitches will be removed after 10 days.

Post operative Regimen

Patient will undergo appropriate physiotherapy in the form of exercises, once the patient is pain free. IV antibiotics and IV analgesics will continue as required for soft tissue healing. After the patient is discharged from the hospital, he will be on regular follow up and assessment of progress

Assessment of complications.

Peroperative – hand or wrist pain ,numbness at hand/ fingers, weakness in hand or wrist , tingling sensations, difficulty with grasping

Late post operative - Patients will be analyzed for any complications such as infection,scar formation, weakness in hand or wrist

The patient shall be under follow up till 6 months post surgery.

DURATION OF STUDY

The purpose of this study is to review and analyse the outcome of procedure. Study would be based on a retrospective and prospective review of the medical records of all cases of CTS who will undergo MINI-INCISION RELEASE between January 2017 and December 2019 at Dayanand Medical college Hospital, Ludhiana.

OUTCOME

Final functional outcome at six months follow up using Boston carpal Tunnel syndrome Questionnaire.

STATISTICAL ANALYSIS

The data collected will be recorded in a proforma and will be analysed using appropriate observational statistical methods.

7.3 DOES THE STUDY REQUIRE ANY INVESTIGATIONS OR INTERVENTIONS TO BE CONDUCTED ON PATIENTS OR OTHER HUMANS OR ANIMALS? IF SO, PLEASE DESCRIBE BRIEFLY.

- Investigations – Routine and others if required.

7.4 HAS THE ETHICAL CLEARANCE BEEN OBTAINED FROM ETHICAL COMMITTEE OF YOUR INSTITUTION IN CASE OF 7.3?

YES, ATTACHED

8. LIST OF REFERENCES

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PROFORMA

Sr. No_____

NAME: AGE: SEX:

ADM No: CR/MRD No:

FATHER'S /HUSBAND'S NAME:

ADDRESS:

OCCUPATION:

DURATION OF SYMPTOMS:

DATE OF ADMISSION:

DATE OF DISCHARGE:

DATE OF OPERATION/PROCEDURE:

EMPLOYMENT STATUS – WORKING/NOT WORKING

GENERAL PHYSICAL EXAMINATION:

PULSE: RR:

TEMPERATURE: BLOOD PRESSURE:

PALLOR: ICTERUS:

CYANOSIS: CLUBBING:

OTHER SYSTEMS INVOLVED:

CHEST: CNS:

ABDOMEN: OTHERS:

Signature of candidate **Signature of supervisor**

LOCAL EXAMINATION

INSPECTION/PALPATION:

INVESTIGATIONS

HB: PTI/INR

B.UREA: S.CREATININE:

RBS:

OPERATION/PROCEDURE:

ANAESTHESIA USED: GA / LOCAL ANAESTHESIA / BLOCK

TYPE OF RELEASE -

DATE OF SURGERY:

APPROACH:

Complications:

Intra-op:-

Post-op:-

Delayed:-

Additional procedures:

Signature of candidate **Signature of supervisor**

Follow up:-

	0-2 weeks (at discharge from Hospital)	3 Months	6 Months	Latest follow-up
RANGE OF MOTION AT WRIST: Flexion Extension Supination Pronation Abduction Adduction **PAIN AT WRIST** **PAIN AT HAND** **NUMBNESS** **WEAKNESS IN HAND OR WRIST** **TINGLING SENSATION** **WRITING** **HOUSEHOLD WORK** **WEIGHT HOLDING** **RETURN OF FUNCTION TO NORMAL LEVEL** **RETURN TO OCCUPATION** **NERVE CONDUCTION STUDIES(NCS)** **EMG**				

Signature of candidate **Signature of supervisor**

Boston Carpal Tunnel Syndrome Questionnaire (BCTQ)

(一) Symptom severity scale (11 items)

	1	2	3	4	5
1. How severe is the hand or wrist pain that you have at night?	Normal	Slight	Medium	Severe	Very serious
2. How often did hand or wrist pain wake you up during a typical night in the past two weeks?	Normal	Once	2 to 3 times	4 to 5 times	More than 5 times
3. Do you typically have pain in your hand or wrist during the daytime?	No pain	Slight	Medium	Severe	Very serious
4. How often do you have hand or wrist pain during daytime?	Normal	1-2 times / day	3-5 times / day	More than 5 times	Continued
5. How long on average does an episode of pain last during the daytime?	Normal	<10minutes	10~60 Continued	>60minutes	Continued
6. Do you have numbness (loss of sensation) in your hand?	Normal	Slight	Medium	Severe	Very serious
7. Do you have weakness in your hand or wrist?	Normal	Slight	Medium	Severe	Very serious
8. Do you have tingling sensations in your hand?	Normal	Slight	Medium	Severe	Very serious
9. How severe is numbness (loss of sensation) or tingling at night?	Normal	Slight	Medium	Severe	Very serious
10. How often did hand numbness or tingling wake you up during a typical night during the past two weeks?	Normal	Once	2 to 3 times	4 to 5 times	More than 5 times
11. Do you have difficulty with the grasping and use of small objects such as keys or pens?	Without difficulty	Little difficulty	Moderately difficulty	Very difficulty	Very difficult

(二) Functional status scale (8 items)：

	No difficulty	Little difficulty	Moderate difficulty	Intense difficulty	Cannot perform the activity at all due to hands and wrists symptoms
Writing	1	2	3	4	5
Buttoning of clothes	1	2	3	4	5
Holding a book while reading	1	2	3	4	5
Gripping of a telephone handle	1	2	3	4	5
Opening of jars	1	2	3	4	5
Household chores	1	2	3	4	5
Carrying of grocery basket	1	2	3	4	5
Bathing and dressing	1	2	3	4	5

INFORMED PATIENT CONSENT

Date: _____

I.....D/o, W/o, S/o.....

am willing to participate in the study **"OUTCOME AND EVAULATION OF MINI INCISION RELEASE FOR CARPAL TUNNEL SYNDROME"** The procedure with its complications has been explained to me in local vernacular language. I have fully understood that no special tests and extra expenditure in any form, merely for the purpose of thesis is being carried out. I am free to opt out the study any time without assigning any reason.

....

Signature of the Witness Signature of the patient

Name:

Signature of Candidate **Signature of Supervisor**

मरीज अनुमति फार्म

तिथि _____

मैं _____ पत्नी/पुत्र/पुत्री _____ निवासी _____ इस शोधकार्य **"OUTCOME AND EVALUATION OF MINI INCISION RELEASE FOR CARPAL TUNNEL SYNDROME"** में भाग लेने के लिए सहमत हूँ। मैं इस शोधकार्य में भाग लेने के लिए अपनी स्वेच्छा से तैयार हूँ। मैं पुष्टि करता/करती हूँ की यह स्वीकृति देने के लिए मुझे कोई आर्थिक प्रलोभन नहीं दिया गया और न ही दबाव डाला गया है। मुझे इस शोधकार्य का उद्देश्य स्पष्ट कर दिया गया है और मुझे यह विश्वास है की यह विज्ञान और मानवता के लाभ के लिए है। मुझे इस शोधकार्य में होने वाले जोखिम के बारे में समझा दिया गया है और मेरी समझ में यह जोखिम बहुत मामुली है।

मैं इस शोधकार्य में भाग लेने के सम्बन्ध में किसी भी समय अपनी अस्वीकृति व्यक्त कर सकता/सकती हूँ और मेरे अस्वीकृति व्यक्त करने का मेरे इलाज पर कोई प्रभाव नहीं पड़ेगा।

_____ गवाह के हस्ताक्षर
नाम:

_____ रोगी के हस्ताक्षर/अंगूठे का निशान
नाम:

_____ अन्वेषक के हस्ताक्षर

_____ विद्यार्थी के हस्ताक्षर

ਮਰੀਜ਼ ਰਜ਼ਾਮੰਦੀ ਫਾਰਮ

ਮਿਤੀ_____

ਮੈ_____ ਪਤਨੀ/ਪੁੱਤਰ/ਪੁੱਤਰੀ_____

ਵਾਸੀ _____

"OUTCOME AND EVALUATION OF MINI INCISION RELEASE FOR CARPAL TUNNEL SYNDROME" ਤੇ ਚਲ ਰਹੀ ਖੋਜ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਰਜ਼ਾਮੰਦ ਹਾਂ। ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਮੈ ਆਪਣੀ ਮਰਜ਼ੀ ਨਾਲ ਤਿਆਰ ਹਾਂ। ਮੈ ਇਹ ਦਸਣਾ ਚਾਹੁੰਦਾ ਹਾਂ/ ਚਾਹੁੰਦੀ ਹਾਂ ਕੇ ਇਹ ਰਜ਼ਾਮੰਦੀ ਦੇਣ ਵਾਸਤੇ ਮੈਨੂ ਕਿਸੇ ਵੀ ਤਰਾਂ ਦਾ ਲੋਭ-ਲਾਲਚ ਨਹੀ ਦਿੱਤਾ ਗਿਆ ਅਤੇ ਨਾ ਹੀ ਕੋਈ ਦਬਾ ਪਾਇਆ ਗਿਆ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਦਾ ਮਨੋਰਥ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਭਰੋਸਾ ਦਵਾਇਆ ਗਿਆ ਹੈ ਕੇ ਇਹ ਖੋਜ ਵਿਗਿਆਨ ਅਤੇ ਮਾਨਵਤਾ ਦੀ ਭਲਾਈ ਲਈ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਵਿਚ ਹੋਣ ਵਾਲੇ ਖਤਰੇ ਬਾਰੇ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਯਕੀਨ ਹੈ ਕੇ ਇਹ ਖਤਰਾ ਬਹੁਤ ਮਾਮੂਲੀ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਦਾ ਢੰਗ – ਤਰੀਕਾ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ।
ਮੈ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਬਾਰੇ ਆਪਣੀ ਰਜ਼ਾਮੰਦੀ ਕਿਸੇ ਵੀ ਸਮੇ ਵਾਪਸ ਲੈ ਸਕਦਾ ਹਾਂ/ ਸਕਦੀ ਹਾਂ ਅਤੇ ਮੇਰੀ ਰਜ਼ਾਮੰਦੀ ਵਾਪਸ ਲੈਣ ਦਾ ਮੇਰੇ ਇਲਾਜ ਤੇ ਕੋਈ ਅਸਰ ਨਹੀ ਹੋਵੇਗਾ।

_____ _____

ਗਵਾਹ ਦੇ ਹਸਤਾਖਰ ਮਰੀਜ਼ ਦੇ ਹਸਤਾਖਰ

ਮਿਤੀ_____ ਮਿਤੀ_____

ਪਤਾ _____ ਪਤਾ _____

_____

ਨਿਰੀਖਕ ਦੇ ਹਸਤਾਖਰ

_____

ਸਿਖਿਆਰਥੀ ਦੇ ਹਸਤਾਖਰ